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Industry Power

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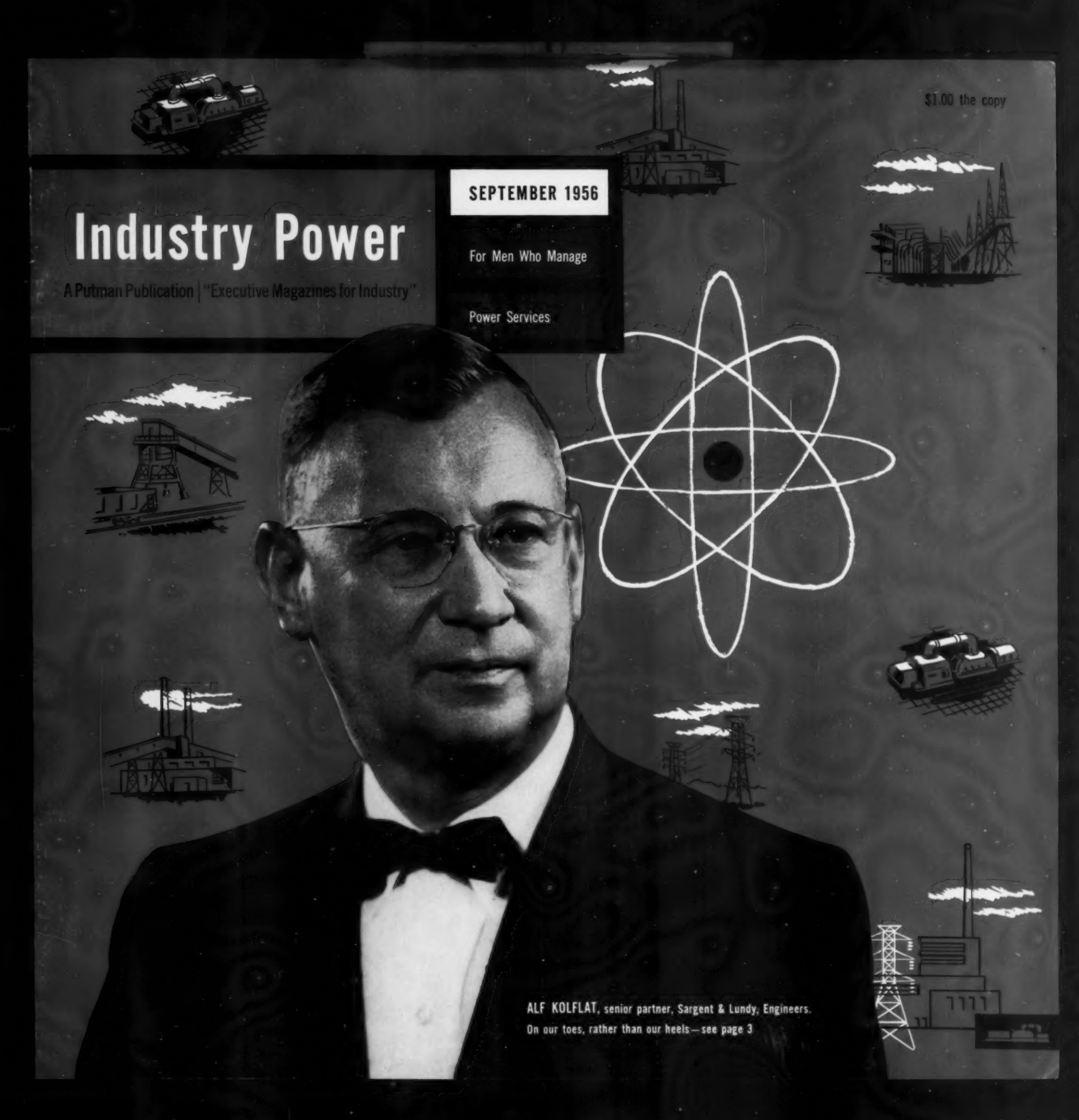
SEPTEMBER 1956

For Men Who Manage

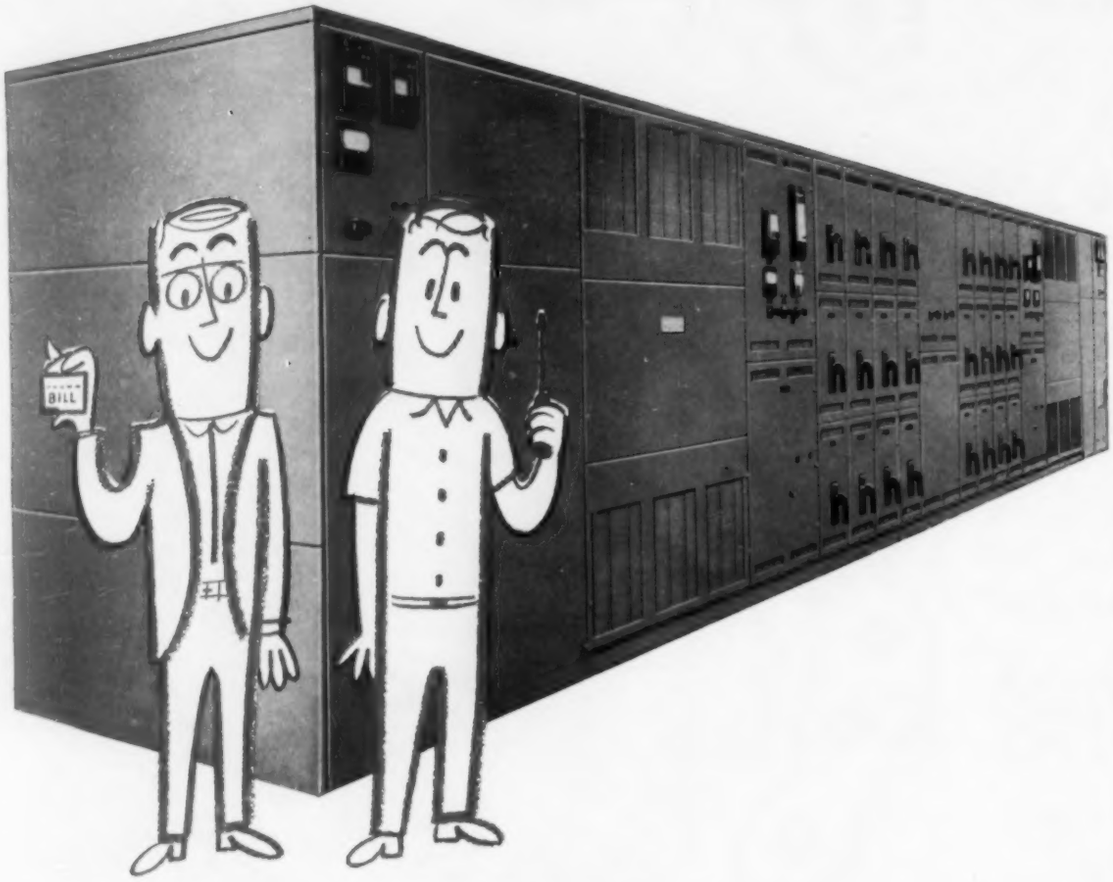
Power Services



ALF KOLFLAT, senior partner, Sargent & Lundy, Engineers.

On our toes, rather than our heels—see page 3

I-T-E Secondary Unit Substations



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Industry Power

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VOLUME 71 NO. 4 SEPTEMBER 1956

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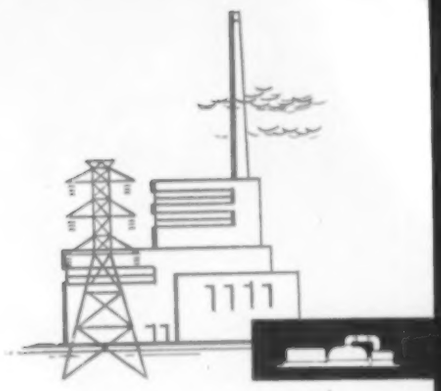
Industry Power Forum



About Alf Kolflat

Some years ago we had occasion to write that Alf Kolflat's career proves that success and integrity are handsome companions. Talking with him again last month, we find him even more a grand testimonial to the engineering profession. Kolflat makes precise distinction between his views as a private citizen and as an engineer with responsibilities to his firm, his clients, and his profession.

His conversation trademark remains a faint trace of a Norwegian accent. He was born in a fishing village in the Lofoten Islands, above the Arctic Circle. When he found his interests extending beyond his father's general store, he began picking up his education for engineering. The United States interested him as a place he "had to see." After some tenure with Armstrong Cork and West Penn Power, he joined the mechanical engineering group at Sargent & Lundy—a firm he had not heard of until then. In his own words, he "stuck to his knitting," did his share of the "dishwashing" that has to be done in every firm, and rose to become the firm's chief executive.

His extra-curricular activities include the Executive Committee of the Power Division of ASME, a trustee of the Western Society of Engineers, and a trustee of the Norwegian-American Hospital.

He is modest, both for himself and for Sargent & Lundy. . . . especially when conversation gets into the domain of services rendered by different consulting engineering firms. He points out that any reputable consulting firm that does 10 or 20 power plants in one year has much to offer a client whose engineers may do but one power plant in 10 or 20 years. Beyond this expression of confidence in the ability of consulting engineers to serve the power field, Kolflat will say no more than that the great bulk of his firm's business is repeat business. No sales organization solicits engineering work for the firm—additional clients are obtained as the result of established performance and friendly recommendations.

Such are the makings of success with integrity.

On our toes, rather than on our heels

Alf Kolflat, Senior Partner,
Sargent & Lundy, Engineers,
as told to Harold A. Bergen, Editor

ENGINEERING SHOULD be objective, but it is interesting to observe to what extent personal preferences and desires affect many decisions. When something is dear to a person, he marshals all the facts he can to back it. This is true in most decisions in life, including those in the power business. People sometimes adjust their yardsticks to justify what they choose to justify and this is not always as bad as it sounds.

As an example, an analysis will show that nuclear power is not yet commercially competitive. This may not be the most important point. The point is that something like it cannot be made to pay until it is built, tried, and improved. An immediate economical justification need not be expected. So suppliers eager to learn for the future are "contributing" to the first reactor power plants at prices insufficient to cover customary costs. (Estimates of nuclear power costs, thus, often are overly optimistic because the first plants are being built at prices not truly profitable to the manufacturers.)

Now, I wish I knew how fast this nuclear development will grow. We can be sure, though, that present "experimental" plants will cost money. If these expenditures are to be justified by suppliers, consulting engineers, and owners, it seems to me that they then can be justified only on the basis of present need for future knowledge. And this is justification enough.

Like all experiments, we are confident that something good and worthwhile will come of this nuclear development. But, not every experiment is successful in producing something attractive. Progress in the power business, as in other fields, is made because *expected* future gains are viewed as attractive enough to permit building to designs that are not economical when first proposed. Progress is not made when we confine our designs to the rigid boundaries of present practice and present economics. Bold future planning makes progress. We, in our office, prefer to stand on our toes than to relax on our heels.

The power business has been characterized by two trends that stack the cards in favor of "standing on our toes." *First*, fuel prices have continually increased. Designs that may not be strictly economical today soon become economical. *Second*, the extra cost of pioneering beyond the limits of present proved-in-operation practice is decreasing with each installation. A power plant that is today "a little ahead of time" remains a pretty good plant after 10 or 20 years.

How far can we go in sticking our neck out for the sake of "progress"? Economics, even for the future can be stretched beyond limits of engineering prudence. Facts can be marshalled to advance the cause of many design concepts to the point where eloquence of argument excels merit of design.

Where does this prudence lie? Every power plant owner must decide how much he can invest in advancing the art. Each engineer, indeed, must constantly re-examine his recommendations to management to see how much of his design depends on personal preference and how much depends on reasonably achievable progress.

Reasonable consistency must follow, too. An economy-minded design should promulgate economy throughout. Liberality "here" and stinginess "there" do not add up to good design. The prudence with which power plant pioneering is done must extend equally to all phases of design. If we are to agree that progress is what we want in the power business, we must agree that we have to build beyond the limits of the economies of this minute. This is how we learn and get knowledge. ♦ ♦

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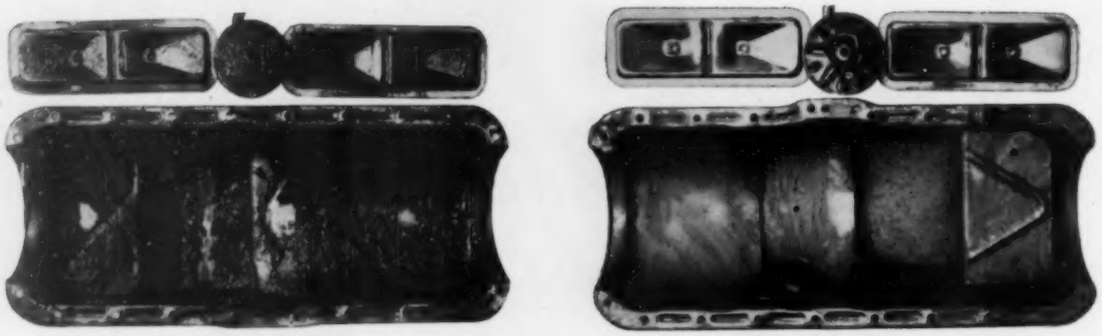
of SINCLAIR Diesel Oil Superiority!



This is actual photographic proof of the superiority of Sinclair Diesel Lubricants. On the left is a truck engine sump in which an ordinary oil was used. The clean sump on the right reflects conditions when a Sinclair Diesel Oil, SUPER TENOL, was used. This same top quality lubrication performance can be expected from all Sinclair Diesel Oils . . . *because Sinclair has the exact oil to match your engine's requirements!*

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For further information about Sinclair's trouble-proof Diesel lubricants, see your Sinclair Representative, or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

DIESEL OILS

Circle 122 on READ-N-CIRCLE card for more data

late news

. . . about industry power

• Opposed piston engine burns any oil

New General Motors GM-14 free-piston engine is rated at 1250 gas horsepower with a thermal efficiency of 43½ percent. One of its main advantages is an insensitive fuel appetite. Engine runs on heavy fuel oil with absolutely clean exhaust. Successful runs have been made on a range of fuels varying from 100-octane gasoline through the gasoline range, kerosene, diesel fuel, Bunker C, and crude oil. It has also been run on vegetable and animal oil, such as whale oil, cottonseed oil, and peanut oil. Only noticeable effect on engine output under these test conditions is that power output varies directly as content of fuel being used.

• Starting salaries still spiraling

Salaries received by 1956 graduates at Illinois Institute of Technology have again reached an alltime high. This year's graduates are earning an average of $391 per month as compared with the 1955 average of $383. Electrical engineers received the highest salaries, $461 per month. Mechanical engineering graduates averaged $424 and civil engineering graduates averaged $434. Each June graduate had personal interviews with an average of eight organizations.

• Michigan's first nuclear power plant

Inaugural ceremonies for Michigan's first atomic-electric power plant project were held last month at the construction site north of Monroe. Plant has been named the Enrico Fermi Atomic Power Plant in honor of the Italian-American physicist who first demonstrated how the atom's power could be harnessed for practical use. Reactor unit is of the breeder type. Research and development work to establish the basic plant design has cost about $8 million. Full-scale reactor parts have been ordered for mechanical testing, including the stainless steel vessel that encloses the reactor core, heavy shield, controls, and fuel handling parts. A centrifugal pump powered by a 1000 horsepower motor will drive molten sodium through the reactor at 11,000 gpm. When full operating capacity is reached, some time ater 1960, plant will supply sufficient electric power for a quarter-million people.

• Honors for Nikola Tesla

One highlight of recent meeting of the International Electrotechnical Commission was the formal adoption of the name "Tesla" for unit of magnetic flux density in the Georgi system. Nikola Tesla, famous electrical inventor, was born in 1856 in Belgrade, Yugoslavia.

• Power show lineup grows and grows

Already some 250 leading manufacturers have reserved display space at the 22nd National Exposition of Power and Mechanical Engineering in New York's Coliseum, November 26-30. A substantial influx of new applications is still expected. Judging by the lineup to date, this looks like the most interesting power show yet.

A PUTMAN PUBLICATION

Industry Power

For men who manage power services

VOLUME 71 NO. 4 SEPTEMBER 1956

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Use this entry blank to enter INDUSTRY POWER's easy Power Show Contest. Here are the rules, details of the prizes, and biographies of the men who will open your entries and act as judges.

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Here's how Jersey Central Power & Light saved 250 tons of steel with expanded-metal cable trough when they added more capacity. Also saved on labor, and maintenance is easy.

which steam-plant extras will pay off? 14
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THORIUM LOOKS PROMISING

One of the most promising present approaches to economic nuclear power is use of thorium as nuclear fuel. Thorium-fuel reactor promises these principal advantages: (a) can be designed for high power density and low fuel inventory; (b) reactor fuel can be purified continuously and simply; (c) high burnup (that is, greater utilization) of thorium fuel may be achieved, giving low fuel cost if processing does not prove too expensive; (d) reactor vessel is of simple mechanical design; and (e) reactor has such a high degree of stability that control rods are not necessary. Inherent disadvantages are high pressures (2000 psi), high temperatures, leakage problems, radioactivity (induced in auxiliary equipment), corrosion, erosion, and decomposition of the reactor moderators.

WHY NUCLEAR POWER?

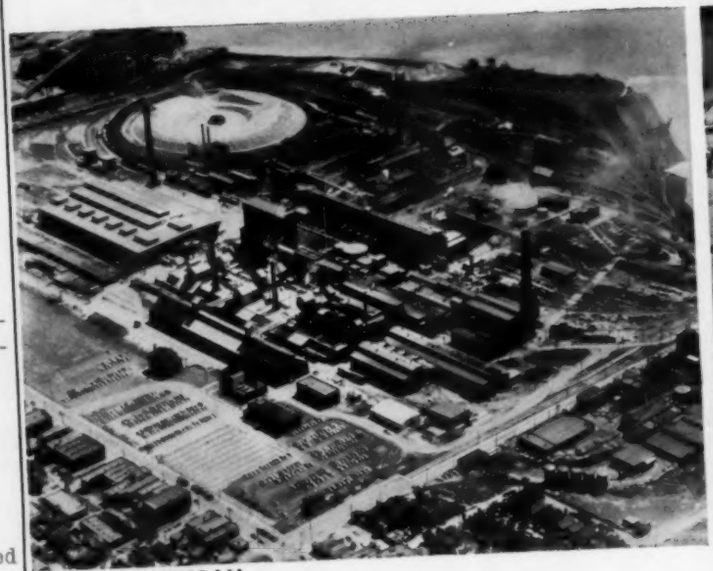
Present annual U.S. power use is estimated at 514 billion kwh. By 1966, conservative estimates place annual power consumption at 1333 billion kwh. A General Electric Company spokesman, pointing this out, thus emphasizes that atomic energy is important only because all energy is important. He points out, further, that conventional fuel supplies face four limitations: (a) total resources are always decreasing; (b) extraction cost may increase rapidly as deposits become harder to get; (c) modern power plants already get one kilowatt-hour from less than one pound of coal; and (d) new uses for fossil fuels, notably for chemical processing, are boosting costs and cutting conventional fuel supplies.

DIVISIONS AND MORE DIVISIONS

Superior Tube Company has formed a Nuclear Products Division, to be headed by John B. Giacobbe. Superior's new division will fabricate components used in nuclear power reactor cores . . . . Crane Company has set up a new Atomic Energy Unit in its Engineering Sales Section, "recognizing the tremend-

AMERICA'S FIRST PRODUCER OF ALKALIES
SOLVAY
75th YEAR 1881-1956

Diamond



DETROIT, MICHIGAN

MOUNDSVILLE, WEST VIRGINIA

SYRACUSE, NEW YORK

BATON ROUGE, LOUISIANA

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INDUSTRY POWER

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Since 1881
B&W Has Supplied
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Solvay's confidence has been built on satisfactory experience with B&W Boilers of many types . . . has been strengthened by a 75-year record of performance and service. For example, in the comparatively short period from the start of World War II to date, this leading industrial company has ordered B&W boilers—including Integral-Furnace and Stirling Units—having a total steam capacity of over 2,000,000 lb per hr.

Advanced research and equipment development to *keep steam generating costs down for requirements of every size* is an established policy at B&W. Add an assurance of service that goes far beyond normal requirements, and you know why industrial, utility, and other users across the nation have made repeat orders an old story at B&W. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-389-1

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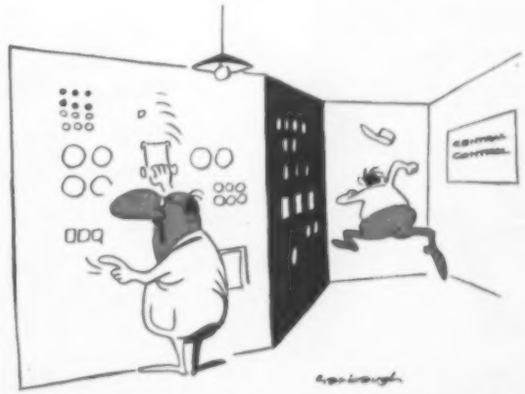
ous potential in nuclear power." The unit, headed by Fred G. Gould, will service inquiries and orders for valves, fittings, and other equipment being supplied for nuclear energy applications . . . . Temco Aircraft Corporation has added a nuclear specialist to its Engineering Department to work on comprehensive reports "on the nuclear field to determine where Temco may develop a nuclear capability." . . . Olin Mathieson Chemical Corporation has formed a Nuclear Fuel Division to produce nuclear fuel elements and reactor cores. Pilot operations are already underway.

AMERICAN FIRM AWARDED DANISH CONTRACT

Foster Wheeler will design and construct a nuclear reactor for the Danish Atomic Energy Commission. Under our Atoms-For-Peace program, the United States will contribute $350,000 toward the total $1.4 million price tag. Reactor will be used for research and training.

SPECIAL ACCESS FOR THERMONUCLEAR DATA

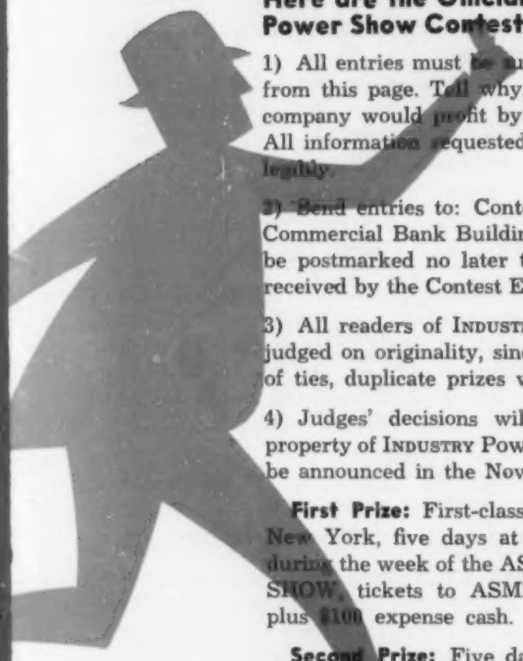
Special conditions for granting access to Secret Restricted Data on controlled thermonuclear processes have been announced by the AEC. Up until this time, dissemination of information (even to those Access Permit holders previously cleared for such information) has been delayed. Permits already issued and applications pending will be reviewed to determine whether these applications meet the special conditions now established. ♦ ♦



Nonsense . . . anybody knows this breaker should be open, and these switches here . . .

Tell us why, in 25 words or less, your company would benefit if you would spend a week at the 1956 Power Show in New York next November 26 to 30. Use the entry blank on this page and . . .

win yourself a free trip to the power show



Here are the Official INDUSTRY POWER Power Show Contest Rules. . . .

1) All entries must be submitted on official entry blank clipped from this page. Tell why, in 25 words or less, you think your company would profit by you attending the 1956 Power Show. All information requested on the entry blank must be filled in legibly.

2) Send entries to: Contest Editor, INDUSTRY POWER magazine, Commercial Bank Building, St. Joseph, Michigan. Entries must be postmarked no later than September 7, 1956, and must be received by the Contest Editor no later than September 14, 1956.

3) All readers of INDUSTRY POWER are eligible. Entries will be judged on originality, sincerity, and aptness of thought. In case of ties, duplicate prizes will be awarded.

4) Judges' decisions will be final. Entries become the sole property of INDUSTRY POWER. None will be returned. Winners will be announced in the November 1956 issue of INDUSTRY POWER.

First Prize: First-class round-trip transportation expenses to New York, five days at the Hotel Statler in New York City during the week of the ASME 1956 Annual Meeting and POWER SHOW, tickets to ASME Annual Meeting events, all meals, plus $100 expense cash.

Second Prize: Five days at the Hotel Statler in New York City during the ASME 1956 Annual Meeting and POWER SHOW, tickets to ASME Annual Meeting events, and all meals.

Enter now! Contest closes September 7, 1956!

To: Contest Editor, INDUSTRY POWER
Commercial Bank Building, St. Joseph, Mich.

Name_____ **Title**_____

Company_____

Street Address_____

City_____ **State**_____

This is why my company would profit by sending me to the Power Show (use 25 words or less):

_____

_____

_____

_____

_____

_____

Date_____ **Signature**_____

Meet Contest Judges

Two distinguished engineers, whose combined careers total almost 100 years' experience in the power services, will judge the INDUSTRY POWER Power Show Contest.

Joseph Pope retired last December from Stone & Webster Engineering Corporation after 47 years' service. A graduate of MIT, he joined Stone & Webster in 1908 as cadet operating engineer. His duties as chief betterment engineer, steam research engineer, consulting engineer, mechanical engineer in charge of power plant design, and finally vice president and director took him on major engineering assignments throughout the country.

Pope

Lawrence

Pope is a Fellow and director of ASME, chairman of its Committee on the Professional Practice of Consulting Engineering, and an alternate representative for ASME on the Board of Directors of the Engineers Joint Council. He is also chairman of the EJC Committee on Consulting Practice. He is a Civil Member of the American Society of Naval Engineers and a licensed Professional Engineer. Pope is chairman of the Advisory Committee for the Power Show.

John H. Lawrence, until his retirement last year, was consulting engineer for Murray Manufacturing Corporation (formerly Metropolitan Device Corp.). Before joining Murray in 1940, he was an engineer for the Interborough Rapid Transit Company. As vice president and later president of Thomas E. Murray Inc., from 1920 to 1937, he supervised design and construction of power stations and industrial plants. He graduated from Cornell University in 1909.

Lawrence is a Fellow and past vice president of ASME, a member of AIEE and the Newcomen Society, and a member and past president of Cornell Society of Engineers. He is a licensed Professional Engineer. Lawrence is vice-chairman of the Advisory Committee for the Power Show.

Pollution or Indians

It would be futile, I believe, to entertain any hope that pollution can be eliminated overnight unless we are willing to give up our automobiles, do without our heating systems, shut down the vast industrial network that provides us with the necessities and luxuries of life, and return to the country—to the Indians. . . .

. . . . Granville M. Read, Chief Engineer
E. I. duPont de Nemours & Company

Why do you get INDUSTRY POWER?

We "hand-pick" the most important men in engineering management of power services throughout industry in the United States. How? We set up standards — ratings of firms and titles plus functions of individuals in such firms. We send INDUSTRY POWER only to those who qualify under our requirements.

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THE EDITORS

BETZ • *A Great Name In Water Conditioning*

"Prescriptions" by the truckload!

Solving industrial water conditioning problems effectively and *economically* requires exacting engineering techniques.

There are no stock answers . . . no stock chemical treatments.

We realize this perhaps more than anyone. In fact, we make a business of it.

For example, each year at our mixing and formulating plants in Pennsylvania, Texas, California, and Quebec, we blend and ship thousands upon thousands of different "prescriptions", each specifically job-engineered to solve some individual water conditioning problem for industry. Because we feel it is so important to "tailor-make" our formulations, each of our plants actually performs the function of a giant industrial pharmacy.

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A 20-minute, no obligation discussion of your plant water problems with a Betz District Engineer is the best investment in time you can make. Call him in today.

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BETZ

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COPPUS

BLUE RIBBON BLOWERS

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VOLUME 71 NO. 4 SEPTEMBER 1956

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- Major articles are indexed on title page. See page 5.
- Advertisers are indexed alphabetically. See page 55.
- Advertisements are indexed by products in handy guide. See page 48.
- Important literature is indexed by products. See page 42.

this month's comment . . . .

the mail we don't open . . .

A mound of unopened letters grows larger and larger every day in our editorial offices.

They are the entries in the INDUSTRY POWER Power Show Contest, which was announced in our August issue.

Why unopened? Because they will be opened, examined, and judged impartially and rigorously by the eminent men who are serving as judges of the Contest.

Immediately upon the close of the Contest — closing date is September 7 — our judges will go to work. Judging will take longer that we first thought; the entries are so many.

Each entry will be given careful, individual attention. Each will be judged on the basis of idea content — orginality, sincerity, and aptness of thought — not tricky wording.

Have you entered INDUSTRY POWER's Power Show Contest? The prizes are well-worth the try. Just write, on our entry blank, 25 words on "This is why my company would profit by sending me to the Power Show."

If you have never attended a Power Show and wonder what it's all about, check back to the December 1955, issue of INDUSTRY POWER for our pictorial report on last year's Power Show.

For details of the Contest — for a description of the judges — for the official entry blank — see page 8. There's still time to enter.

John Paul Taylor

John Paul Taylor
Editor and Publisher

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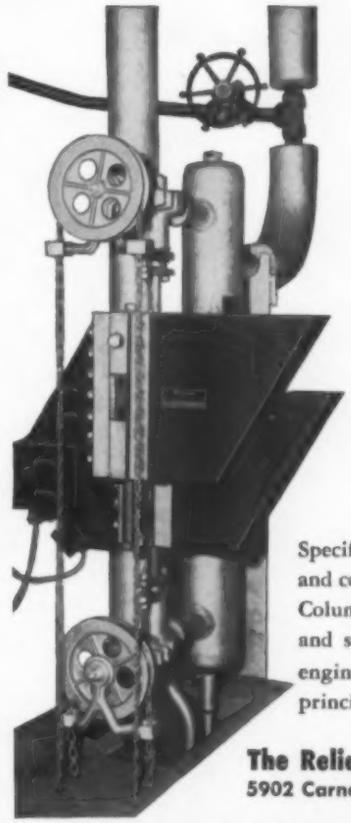
Gages and Safety Specialties
assure you the utmost in *Dependability*



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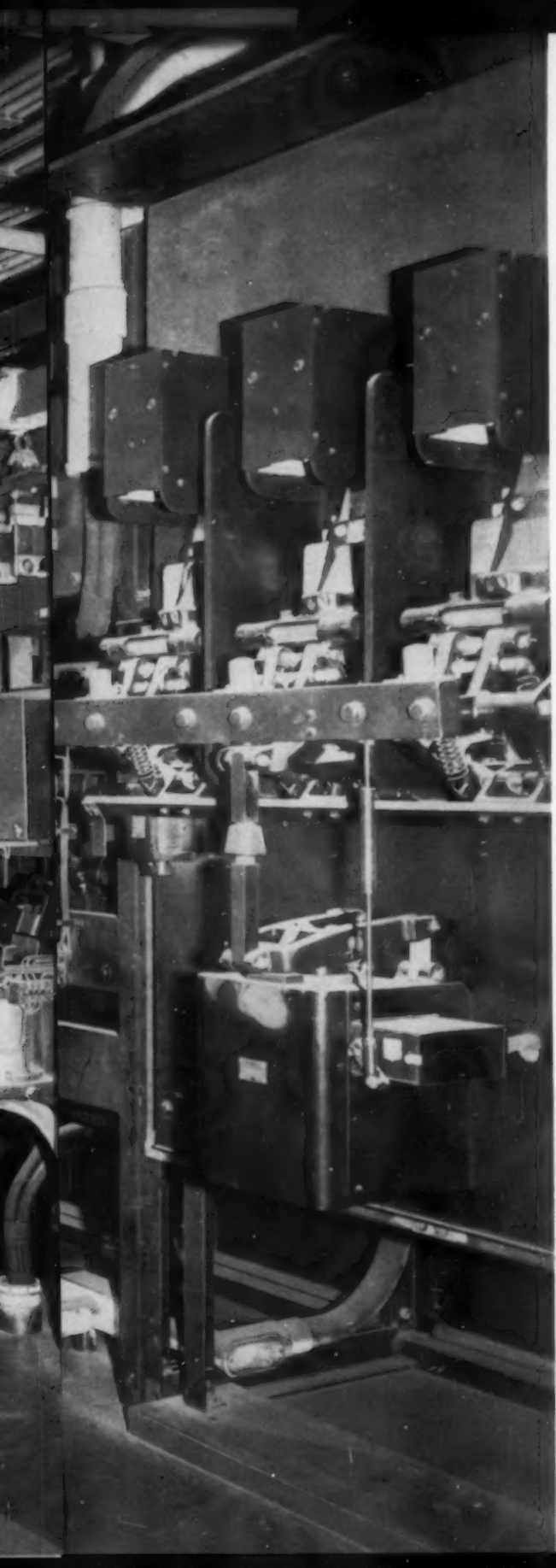


We saved 250 tons of steel with cable trough at Jersey Central

JOHN E. CASEY
Generating Station Superintendent
Jersey Central Power & Light Co.
With R. W. De Moss, Assistant Editor

INCREASED GENERATING CAPACITY required corresponding increase in distribution capacity at Jersey Central Power & Light Co.'s E. H. Werner station. Close scrutiny of all available cable supporting systems resulted in choosing expanded-metal cable trough to do the job.

Our generating station presents an unusually good chance to compare two entirely different cable supporting systems. Our E. H. Werner station was first cut in during 1930. Then, of course, conduit was commonly used to support all cables. Originally, we had two 25,000-kw generators. In 1953, one new 62,500-kw generator was added. At that time, the two original generators were increased to a capacity of 27,500 kw each. Our old generators, therefore, generated 55,000 kw, the new one 62,500 kw.

After studying all the different systems of supporting power and control circuits, we finally settled on expanded-metal cable trough. We are convinced that this is a wise choice for both economy and operating efficiency.

Eliminating conduit was one effective way of reducing costs in our new addition. With more than 100 miles of cable to support over spans of two miles, careful consideration was given to time and materials needed to complete the job. After analyzing installation and maintenance costs of a trough system, there is no doubt in my mind that a cable trough system is less costly and is easier to maintain.

compare installation costs

About 15,000 ft of expanded-metal cable trough was installed in our new addition. Different widths and lengths and numerous fittings were necessary. Biggest single cost saving with a trough system clearly is the time saved during installation. With labor costs being what they are today, it is well to compute these costs carefully.

Two 12-inch cable troughs (above operator) carry more power in less space than all conduit shown.

A single cable trough connection takes from 10 to 20 minutes using nuts, bolts, and washers. Newer trough design uses a pin driven between two interlocking barrels, speeding connections. Each conduit connection, however, takes at least ½ hour to complete, and there are far more conduit connections than trough connections. A single 24-inch wide trough, for example, will support roughly 16 times more power cable than a single 4-inch rigid wall conduit. Additional time required to connect all the conduit runs is very costly.

When installing control cables, time saved is even greater. Control cables can be loaded into a trough without concern for current derating.

planning simplifies installation

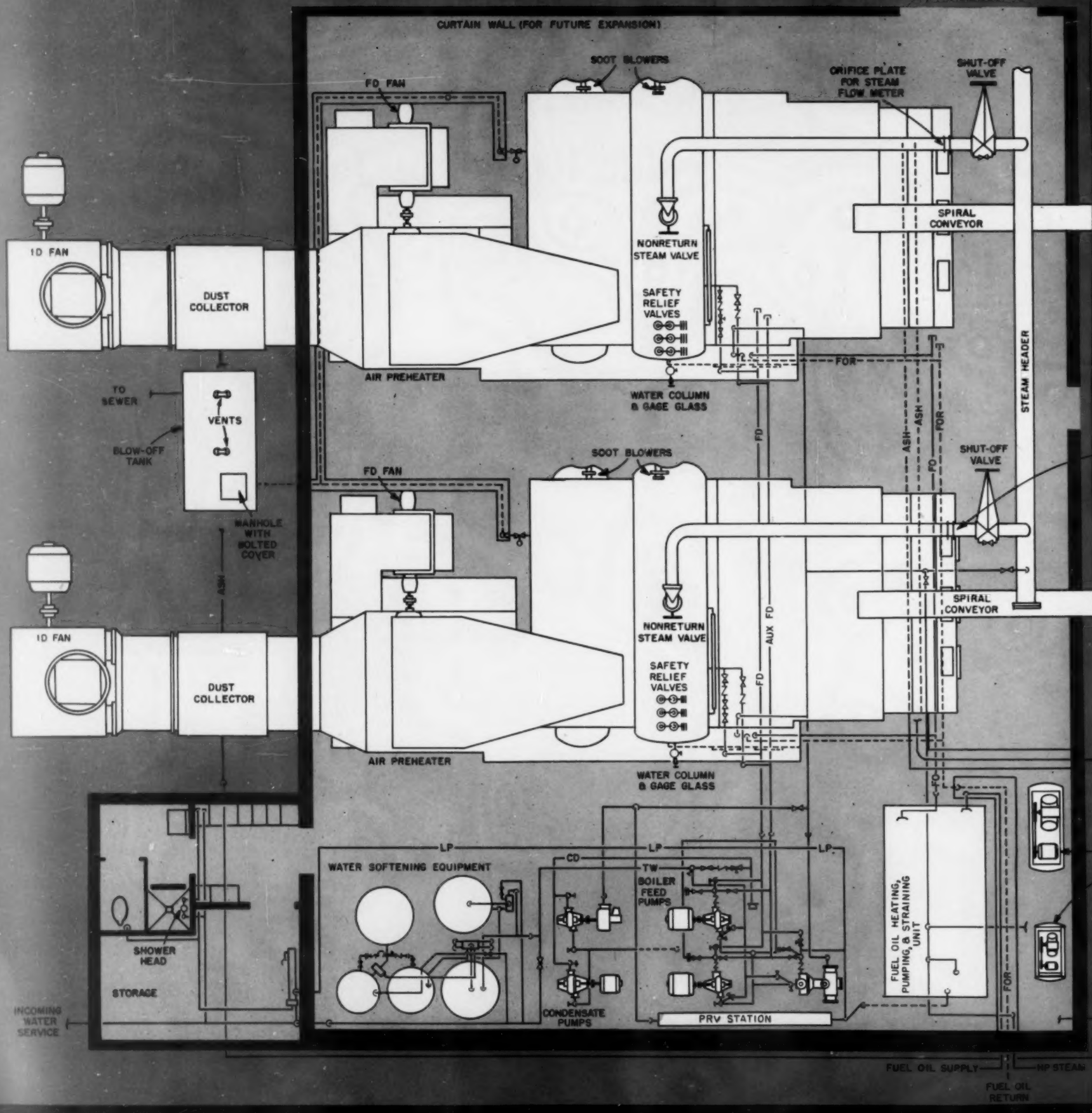
We found that installation could be simplified by connecting several lengths of trough on the floor and lifting into place together. Since conduit is much heavier than trough, each piece must be secured in place. Connections, therefore, must be made where working conditions might be difficult. I would estimate that our installation time costs were considerably less than half of what they would have been had we used a conduit system.

We saved more than a ton of steel in every 60 feet of cable trough of our new system. On the total installation, we saved approximately 250 tons of steel. One 10-foot run of 18-inch trough supports as much cable as ten 10-foot lengths of 4-inch rigid wall conduit. This 60 feet of conduit weighs 200 pounds more than the 10-foot length of 18-inch trough that provides an equivalent cable-carrying capacity. And this is not all. Material savings are further increased because lighter supports are required for the lighter trough system.

While on the subject of supports, we discovered that the cantilever type is simpler to use than the trapeze type because cable can be laid over the open trough edge rather than being pulled through between uprights.

Any steam generating station has a space problem, particularly when under construction. Cable trough saves so much space that we often wondered how we ever installed conduit in 1930. Not only was

(continues on page 32)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SHUT-OFF VALVE
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WATER COLUMN & GAGE GLASS
STEAM HEADER
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STORAGE
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CONDENSATE PUMPS
PRV STATION
FUEL OIL SUPPLY
HP STEAM
FUEL OIL RETURN

U. S. Navy Bureau of Yards and Docks buys hundreds of boilers for shore use every year. Here's a rundown of the experience that saves taxpayers' money, and can save your company's money, too, when you ask

Which extras will pay off in our *NEXT STEAM PLANT?*

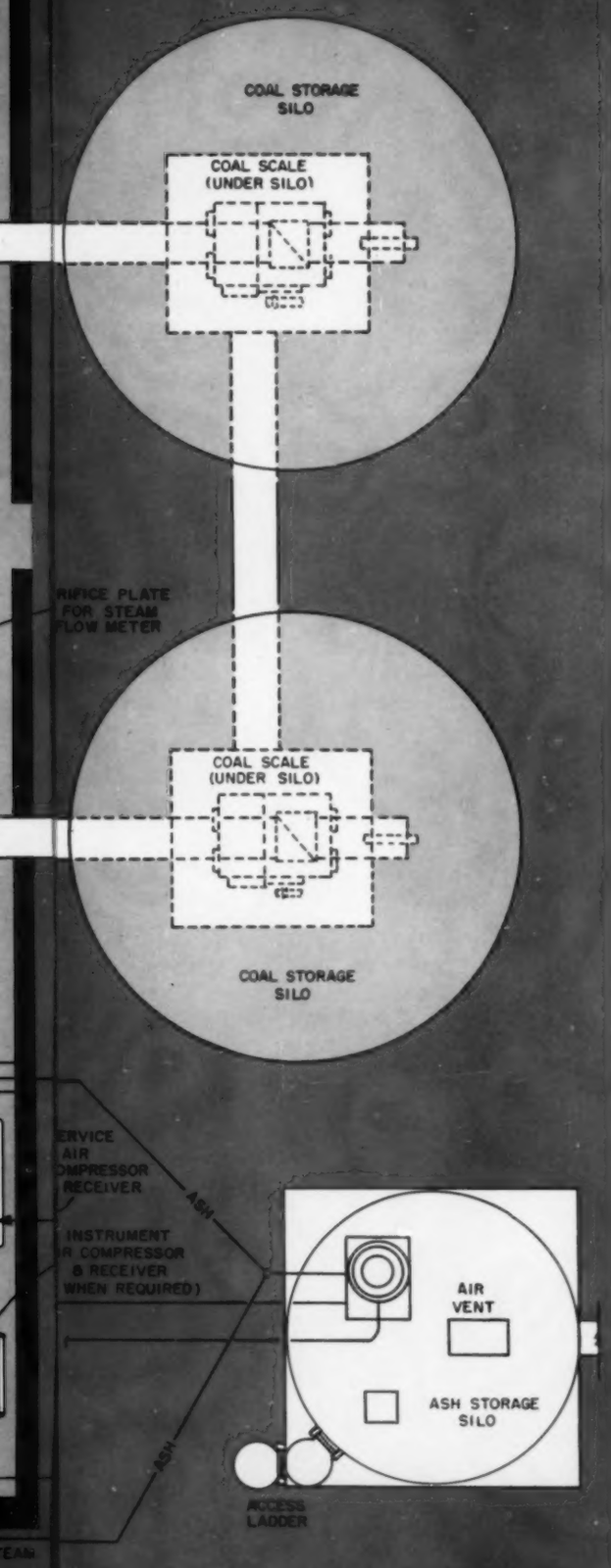
JOHN BISHOP
Mechanical Engineer
Power Generating Section
U. S. Navy Department, Bureau of Yards and Docks

with DONALD HARTLEY, Managing Editor

GOING TO NEED more steam? Well, you *know* that a *minimum* initial expenditure is required. For instance, you *could* get your steam from hand-fired boilers without any controls, any feedwater heaters, or any water treatment. Although construction of a minimum-price plant results in lowest cost of ownership and annual fixed charges, the increased operating cost of a completely stripped-down plant more than offsets the initial savings.

Additional features, over and above the required minimum, could include turbine-driven auxiliaries, automatic combustion controls, conservatively designed boilers, equipment for burning a cheaper fuel, and so on. All these features cost more initially, but give lower operating costs through lower auxiliary power demand, better combustion with less labor, more efficiency with less maintenance, and lower fuel costs.

- For lowest first cost (and annual fixed charges), steam plant capacity should not exceed actual demand anticipated, plus a minimum reserve to prevent excessive financial loss from an unscheduled outage. This reserve should allow for scheduled maintenance during off-peak-load periods. Insufficient capacity may curtail service during an unscheduled outage, cause excessive overloading during peak load periods, and and prevent scheduling of downtime for maintenance. Excessive capacity, on the other hand, increases maintenance costs as well as installation and fixed charges.
- Where the three most common fuels are available, gas usually costs less initially, with oil and coal, respectively following. Fuel burning capabilities of the plant (or plant extension) that you intend to build should provide the lowest total annual cost to own and operate. This means annual fixed charges *plus* cost of fuel purchase, delivering to site, handling firing and all boiler plant maintenance costs.
- A high-thermal-efficiency design usually increases initial cost and subsequent fixed charges. But it does reduce the amount of fuel required to produce needed steam.
- Generally speaking, simpler plant design means lower installation cost (and lower annual fixed charges). Simpler and more functional design reduces cost of operating labor and maintenance.
- More automatic control raises plant cost and subsequent fixed charges. Properly engineered automatic controls, however, improve thermal efficiency, reduce operating labor requirements, and provide extra safety by reducing the hazards of the human element.



Plan view of combination coal and oil fired plant shows some of the extras that must be considered.

is an additional feature justified?

When are extra features (over and above the minimum first cost plant) justified? This usually can be answered by comparing annual savings due to the additional feature against additional annual fixed charge because of it. Fixed charge must be based upon cost of the additional item and your company's policy on amortization and interest.

Two companies building identical plants, for instance, find that using turbine-driven auxiliaries within heat balance limitations saves $2000/year, but will cost $20,000 more than installing electric drives throughout. Company "A" capitalizes its money in 20 years at 4-percent compound interest. Company "B" uses 10-year amortization at 6-percent interest. Referring to the annuity table (page 31),

(continues on page 30)

L&N
71704

Here are details, charts, and nomographs showing how Kalamazoo Vegetable Parchment Co. evaluates and compares different coals to determine how to

Get the *Best* Coal Buy

EDWARD A. WADE
Project Engineer
Kalamazoo Vegetable Parchment Co.

Edward A. Wade graduated from Northeastern University School of Engineering with an electrical engineering degree in 1924. Since graduation, Wade has worked continuously in the field of power plant design, operation, and testing. His experience includes responsible positions in the power field with the Chile Exploration Co. (subsidiary of the Anaconda Company), Fraser Paper Co., and E. I. duPont de Nemours & Company. He was formerly mechanical engineer on the staff of Stone & Webster for eight years before joining KVP. Wade is a registered professional engineer in the states of New York and Massachusetts. He is a member of NSPE.

reported by R. W. DE MOSS
Assistant Editor

MUCH-USED PRACTICE of buying coal on cents-per-million-Btu basis is not the most satisfactory answer to the problem of getting maximum fuel economy. E. A. Wade, project engineer, Kalamazoo Vegetable Parchment Company, has combined years of experience with engineering ability to develop a system that will help you get maximum economy from your coal purchases.

This method of evaluation was developed to determine the suitability of burning coal from new sources in high-pressure boilers, and to determine the comparative costs of producing steam with different kinds of coal.

Analysis procedure shows that coal purchases based on a cents-per-million-Btu basis are actually costing industry many thousands of dollars. Many coals, which appeared economical from the former basis, are more expensive when all phases of coal handling, firing, and ash removal are considered.

To make an equitable preliminary comparison, the same operating basis must be applied to each

Modern coal-handling equipment is designed for maximum flexibility in handling various types of coal.

COAL EVALUATION

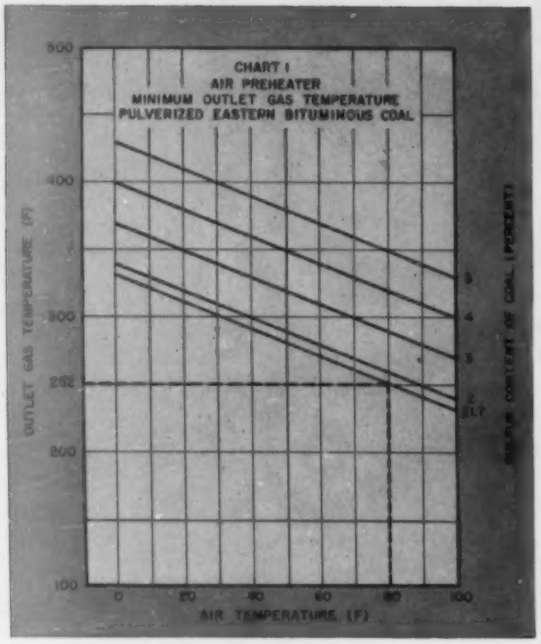
COAL DATA		OPERATING DATA		
Coal Source		**Operating Conditions**		
1 State	KENTUCKY (EAST)	27 Steam Generated		175000 LB/HR
2 County	BELL	28 Steam Pressure		860 PSIG
3 Shipping Point	BELL COUNTY	29 Steam Temperature		825 °F
4 Trade Name of Coal		30 Enthalpy of Steam		1409.7 BTU/LB
5 Mine Name	[redacted]	31 Feedwater Temperature		230 °F
6 Operating Company		32 Enthalpy of Feedwater		198.2 BTU/LB
7 Sales Organization		33 CO_2 in Flue Gas		15.0%
8 Type Mine	DRIFT	34 Gas Temperature from Preheater		289°F
9 Bed	MASON	35 Air Temperature to Preheater		80 °F
10 Size of Coal	CARBON	36 Loss - Moisture in Gas		4.27%
11 Preparation and Treatment	—	37 Loss - Moisture in Air		0.09%
		38 Loss - Carbon in Refuse		0.89%
Proximate Analysis, (As Rec'd)		39 Loss - Heat in Gas		4.75%
12 Moisture	4.8%	40 Loss - CO in Gas		0.00%
13 Volatile Matter	35.9%	41 Loss - Radiation		0.56%
14 Fixed Carbon	52.6%	42 Loss - Unaccounted for		1.50%
15 Ash	6.7%	43 Total Losses		12.06%
16 Heat Value	13290 BTU/LB	44 Boiler Effeciency		87.94%
17 Sulfur	0.8%	45 Heat Added in Boiler per Lb Coal		11687 BTU
18 Ash Softening Temperature	2620 °F	46 Steam Evaporated per Ton Coal		19293 LB
19 Hardgrove Grindability	60			
Ultimate Analysis, (As Rec'd)		**COST CALCULATIONS**		
20 Carbon	—	47 Cost per M Lb Stm per $1 per Ton		$0.0516
21 Hydrogen	—	48 Cost of Coal per Ton		3.750
22 Nitrogen	—	49 Freight and Tax per Ton		4.840
23 Oxygen	—	50 Cost Coal Handling per Ton		0.001
24 Sulfur	—	51 Cost Ash Handling per Ton Coal		0.023
25 Ash	—	52 Cost Induced Draft Fan Power		0.073
26 Moisture	—	53 Cost Forced Draft Fan Power		0.038
		54 Cost Pulverizer Power		0.069
SUITABILITY CHECK		55 Adjusted Cost per Ton Coal		8.794
Volatile Matter, Dry	37.7%	56 Adjusted Cost per M Lb Steam		$0.456
Minimum Outlet Gas Temp.	252°F			
Furnace Temperature	2060°F	Remarks:		

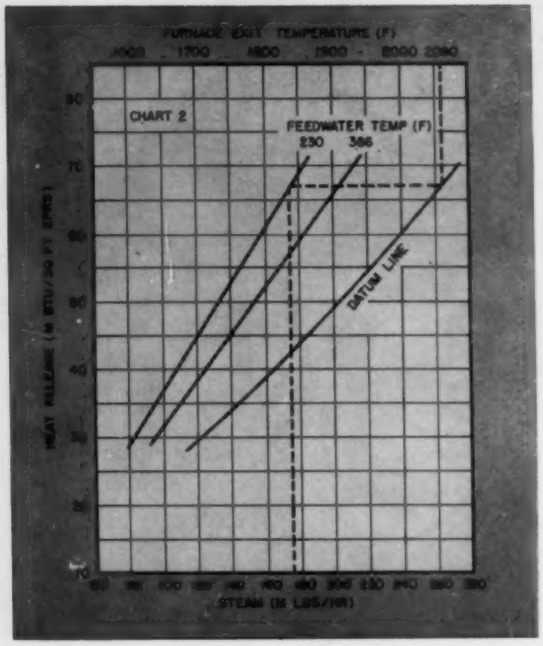
BTU/LB MOISTURE & ASH FREE: 16020
B of M AUG. FOR MASON SEAM BELL COUNTY: 15000

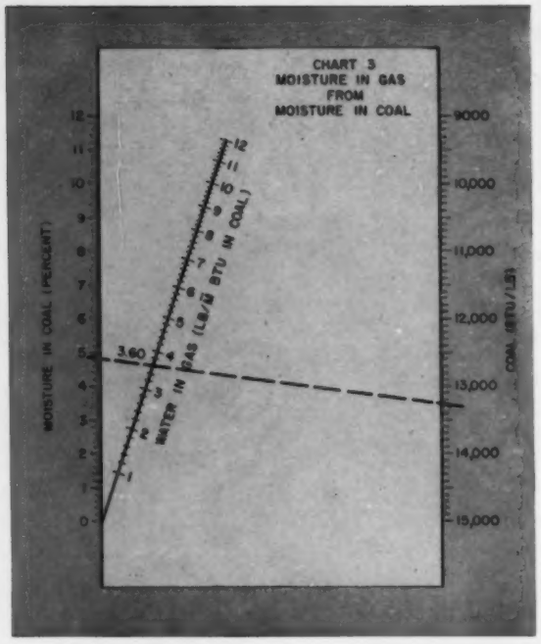
ANALYSIS AVERAGE OF 8 SEPARATE COAL SAMPLES

Coal Date JULY 1956 TEST RUN

Data is recorded in a single table for each coal tested. Tables are compared to subsequent coal checks.







type of coal. Operating conditions are fixed as given in the boiler manufacturer's guarantee as follows:

TABLE I

	A Without closed feedwater heater	B With closed feedwater heater
Steam output (lb/hr)	175,000	200,000
Steam press. (psig)	860	860
Steam temp. (F)	825	825
Air temp. to preheater (F)	80	80
Gas temp. from preheater (F)	288	289
CO_2 in flue gas (percent)	15	15
Feedwater temp. (F)	230	386

These physical and chemical properties of the coal must be known: proximate analysis (volatile matter, fixed carbon, moisture, ash, sulphur, and Btu/lb), ash-softening temperature, and grindability. An ultimate analysis, if obtainable, is also desired since it can be used in making more exact combustion loss determinations.

start evaluation with known data

To demonstrate the evaluation method, a coal known to many will be used as an example. This coal is mined from Mason Seam in Bell County, eastern Kentucky. Start evaluation by entering all known data on lines 1 to 26 of Table I (overleaf). Enter assigned data on lines 27 to 35, if a preliminary evaluation is to be made. Enter instrument data if evaluation is to be made for operating conditions In this example, assigned data from column A are used. Sufficient data have now been assembled to evaluate the coal.

Coal under consideration for our needs must fall in the high volatile bituminous classification (volatile content more than 31 percent on a dry basis). A lower volatile content is unsuited for our installation from the standpoint of flame stability. Volatile content of this coal is 37.7 percent on a dry basis and is, therefore, acceptable.

Sulfur content of the coal must be considered with respect to preheater outlet gas temperature. This temperature must be maintained above the SO_2 dew point to avoid cold end corrosion in the air preheater.

Chart 1 has been developed from information furnished by air preheater manufacturers to show minimum outlet gas temperature that can be tolerated without having corrosion. Chart 1 applies to eastern coals and includes coals from Virginia, West Virginia, Tennessee, and eastern Kentucky. Charts are available for midwestern coals including coals from western Kentucky, Ohio, Indiana, and Illinois.

Coal under consideration is from eastern Kentucky and, therefore, Chart 1 is used. Enter bottom of chart at 80 F, proceed vertically to the curve applying to 0.8 percent sulfur, and read minimum acceptable gas temperature as 252 F. Since actual preheater outlet gas temperature (given on line 34) is 288 F, the temperature is well above the minimum acceptable, and this coal is satisfactory from the standpoint of sulfur content.

NOTE: It is possible to raise outlet gas temperature by increasing excess air to the furnace (or by recirculating heated air to the preheater). This can be done only at a sacrifice of boiler efficiency and should normally not be done to make a high sulfur coal acceptable.

Furnace temperature must be lower than coal ash-softening temperature. Slagging will occur on furnace walls and boiler tubes if furnace temperature is higher than ash-softening temperature. Furnace temperature is determined from Chart 2 to be 2060 F, which is below the ash-softening temperature of the coal. This coal is, therefore, acceptable.

additional charts can be used

If the CO_2 and ambient temperature do not duplicate standard conditions during operating coal checks, other charts can be used to determine furnace temperature. Ambient temperature must be added to temperature rise obtained from these other charts to obtain furnace temperature. Chart 2 was developed from ASME tests. Other charts are calculated by Orrock's modification of the Hudson formula. A knowledge of the effective projected radiant surface area is required to use these charts. Each of our high-pressure boilers has an EPRS of 3685 square feet. While these charts do not check exactly, the difference is so small it will not affect the results.

Moisture in flue gas comes from two sources, the total moisture in the coal and water formed from burning hydrogen in the coal. Moisture in the coal considered is 3.60 pounds/million Btu (from alignment Chart 3). Water formed from burning

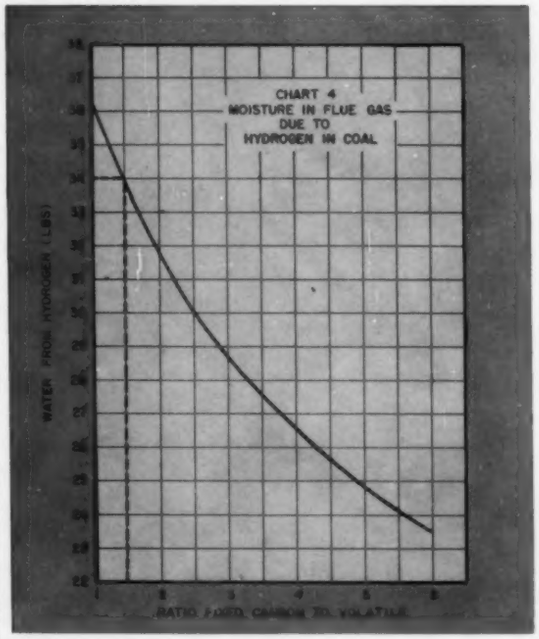
hydrogen is determined from Chart 4. First, calculate the ratio of fixed carbon to volatile matter by dividing line 13 into 14 (1.465). From Chart 4, this ratio corresponds to 34.0 pounds of water. Adding the two water quantities gives 37.6 pounds. Using this value in Chart 5 gives a gas-moisture loss of 4.27 percent. Enter this value on line 36.

determine air input

Determine the air weight per-million-Btu input by entering Chart 6 (page 26) at 15-percent CO_2, then proceed to the high volatile curve, then vertically to the air curve. Read the air weight per-million-Btu as 923 pounds. Using this figure with Chart 7 (page 27) gives an air-moisture loss of 0.09 percent. Enter this figure on line 37.

Loss due to carbon in refuse is really unburned coal. This loss varies with the coal composition. First, determine the volatile matter in the coal on a moisture-and ash-free basis by this formula:

$$\frac{(\%\text{ volatile, as rec'd})\ (100)}{100 - \%\text{ moisture} - \%\text{ ash}} = \%\text{ volatile, moisture and ash free}$$



This gives 40.6 percent for the coal considered.

Reference to Chart 5 shows the corresponding carbon loss to be 0.89 percent. Enter this on line 38. Other charts can be used to determine this loss under operating conditions, provided the ultimate analysis of the coal is known. Heat loss per pound of coal corresponding to 0.89 percent is (0.0089) (13,290) = 118 Btu. This corresponds to 0.01 pounds of carbon. This figure will be used in determining loss due to heat in flue gas.

Enter Chart 6 (page 26) at 15-percent CO_2, proceed horizontally to the high volatile curve, then vertically to the gas curve and read 995 pounds of gas per-million-Btu. From this, subtract the weight of water formed from burning hydrogen (which was found to be 34.0 pounds when calculating loss due to moisture in flue gas) and obtain 961 pounds of dry gas per-million-Btu. This figure must be further adjusted for unburned carbon by multiplying by 1.00 minus the pounds of carbon lost:

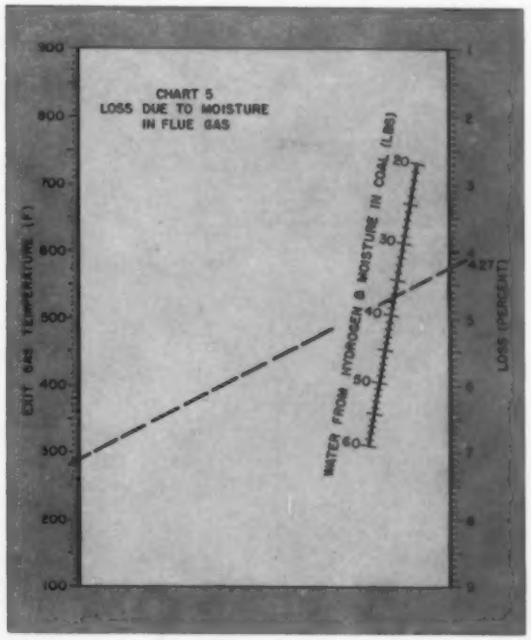
(961) (1.00 - .01) = 951.4 lb.

Using this figure with Chart 8 (page 27) shows loss (heat in gas) as 4.75 percent. Enter this on line 39.

Since CO is rarely encountered in burning pulverized coal, this loss is taken as zero and is so entered on line 40. If, during actual operation, CO is found in the gas, the loss can be determined from other charts, provided the ultimate coal analysis is known.

determine radiation loss

Radiation loss, a function of actual boiler output and maximum continuous boiler capacity, is determined from other charts. Determine radiation loss for type of boiler used (in our case 0.56 percent) and enter this on line 41. Radiation loss is, of course, dependent upon the number of water walls in your boiler. This information must be known to determine an accurate radiation loss.



American Boiler Manufacturers' Association has established a value of 1.5 percent for unaccounted losses. Enter this value on line 42.

(continues on page 26)

Wilson Tube Cutter

CUTS COSTS!

The Wilson Tube Cutter costs two to eight times less than competitive tools. You also get a tube cutter with eight exclusive features:

(1) It has fewer working parts. (2) It can cut non-ferrous tubes in under four seconds. (3) You can chuck it into your own air or electric drill. (4) It has a replaceable spacer collar to adjust for tube thickness. (5) The cutter bit retracts after withdrawal of the cutter. (6) You have a choice of round or taper shank in smaller sizes. (7) To operate, you insert the cutter in the tube, switch on the power, and press forward. (8) It takes the punishment of constant use.

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B Tube Knockout tool for manual or mechanical use.

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JOHN F. LEE
Professor of Mechanical Engineering
North Carolina State College
with DONALD HARTLEY, Managing Editor

AIR REFRIGERATORS operate on a reversed *Brayton* cycle. This type of refrigerator is used where the safety of using air as a refrigerant and when light weight (when centrifugal machines are used) are important. Many applications are found in gas liquefaction and perishables transportation.

Fig. 1 shows air refrigeration cycle on *T-s* and *p-v* diagrams. Air expands at constant entropy from point *a* to point *b*. Heat is absorbed from the refrigerated space during constant-pressure process *bc*. Air is then compressed at constant entropy in the process *cd* to the pressure maintained in the cooler. Finally, air is cooled at constant pressure from point *d* to *a*.

Coefficient of performance of a refrigerator is

$$\text{cop} = \frac{Q_A}{W_{net}} = \frac{Q_A}{Q_R - Q_A} \qquad (1)$$

For the air refrigerator, this gives a coefficient of performance

$$\text{cop} = \frac{h_c - h_b}{(h_d - h_a) - (h_c - h_b)}$$

This equation can be expressed as

$$\text{cop} = \frac{c_p\ (T_c - T_b)}{c_p\ (T_d - T_a) - c_p\ (T_c - T_b)}$$

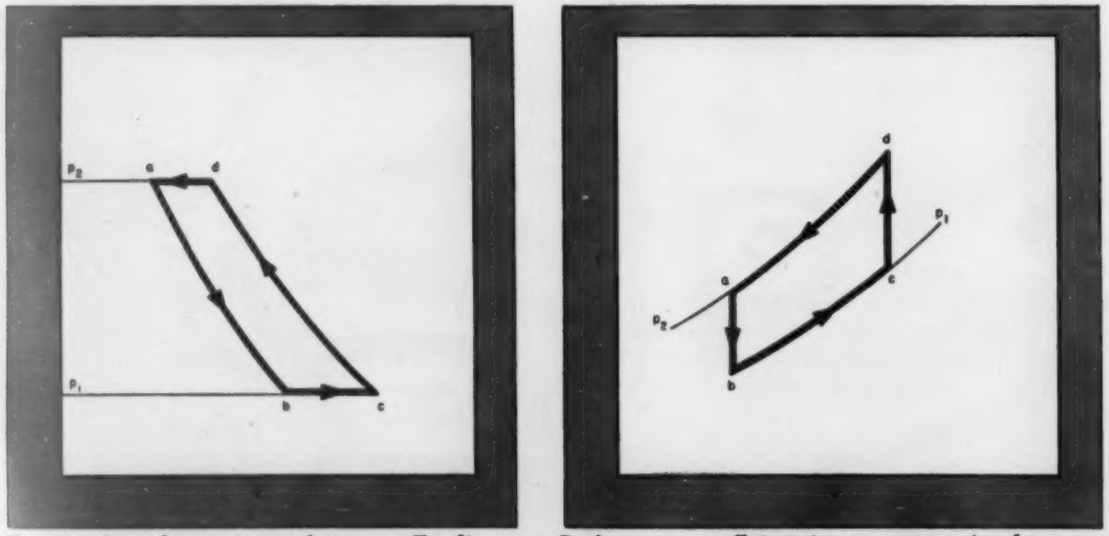

Fig. 1 — Air refrigeration cycle on p-v, T-s diagrams. Performance coefficient increases as p_2/p_1 decreases.

Cancelling specific heats, we get

$$\text{cop} = \frac{1}{\frac{T_d - T_a}{T_c - T_b} - 1} \qquad (2)$$

For the two constant entropy processes we have

$$\left(\frac{p_2}{p_1}\right)^{(k-1)/k} = \frac{T_d}{T_c} = \frac{T_a}{T_b}$$

where k = ratio of specific heats $= \frac{c_p}{c_v}$

From the preceding equation, we get

$$\frac{T_c}{T_d} = \frac{T_b}{T_a}$$

$$\frac{T_d}{T_a} - 1 = \frac{T_c}{T_b} - 1$$

Now, Eq. (2) can be written

$$\text{cop} = \frac{1}{\frac{T_a(T_c/T_b - 1)}{T_b(T_d/T_a - 1)} - 1}$$

$$= \frac{1}{(p_2/p_1)^{(k-1)/k} - 1} \qquad (3)$$

This expression, which presupposes a reversible cycle, indicates that coefficient of performance is increased as pressure ratio p_2/p_1 is decreased. A similar expression for the coefficient of performance of the Carnot refrigerator can be derived. Then the lowest possible value of the pressure ratio is that obtainable for a Carnot refrigerator operating between the same temperature limits. This means, in effect, that when the pressure ratio of the air refrigerator is reduced, T_d approaches T_a and T_b approaches T_c, so that a Carnot refrigeration cycle is obtained in these limits. Thermodynamically, coefficient of performance of the air refrigerator approaches that of the Carnot refrigerator as pressure ratio is reduced. Unfortunately, volume of the air

refrigerant also increases when pressure ratio is reduced. Air volume becomes impractically large when pressure ratio approaches that of the corresponding Carnot refrigerator.

EXAMPLE: Air enters the compressor of an air refrigerator at a temperature of 70 F and at a pressure of 15 psia. It is compressed to 60 psia. Adiabatic efficiency of the compressor is 0.75. Pressure in the cooler remains constant at 60 psia. Air leaves the cooler at 25 F and expands in a small turbine whose internal engine efficiency is 0.80. Finally, air passes through a cold storage room at constant pressure before re-entering the compressor. Neglecting heat losses in connecting pipes, and assuming the mechanical efficiencies of the compressor and turbine are each 0.98, determine (a) temperature of air leaving the compressor and turbine, (b) coefficient of performance, and (c) power required in kilowatts for 150 lb/min air flow through the refrigerator.

SOLUTION: (a) Referring to Fig. 2, $p_c = 15$ psia, $T_c = 70\ F = 530\ R$, and $p_d = 60$ psia. For the constant entropy compression process cd we can write

$$T_d = T_c \left(\frac{p_d}{p_c}\right)^{(k-1)/k}$$
$$= 530 \left(\frac{60}{15}\right)^{(1.4-1)/1.4}$$
$$= 787\ R = 327\ F$$

Actual temperature at end of irreversible compression process cd' is

$$T_{d'} = T_c + \frac{1}{e_c}(T_d - T_c)$$
$$= 70 + \frac{1}{0.75}(327 - 70)$$
$$= 413\ F = 873\ R.$$

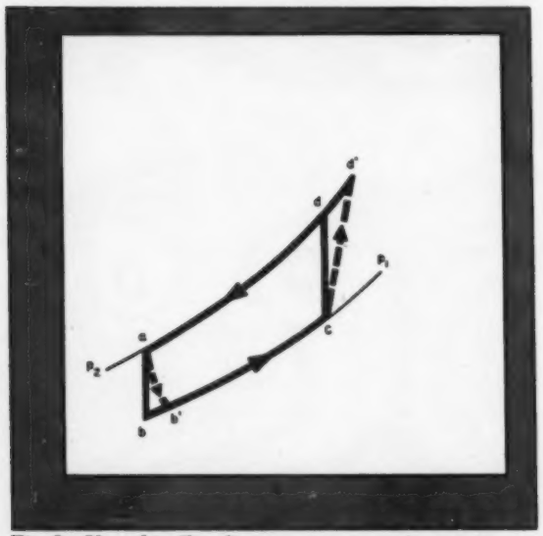

Fig 2—Use this T-s diagram in example on air refrigeration cycle with constant entropy compression.

For constant entropy expansion process ab

$$\frac{T_a}{T_b} = \left(\frac{p_a}{p_b}\right)^{(k-1)/k}$$

$$\text{or } T_b = \frac{T_a}{\left(\frac{p_a}{p_b}\right)^{(k-1)/k}}$$

Since $p_a = 60$ psia, $p_b = 15$ psia, and $T_a = 25\ F = 485\ R$,

$$T_b = 485/\left(\frac{60}{15}\right)^{(1.4-1)/1.4}$$
$$= 326\ R = -134\ F$$

Actual temperature leaving turbine at end of actual expansion process ab' is

$$T_{b'} = T_a - e_t\,(T_a - T_b)$$
$$= 25 - 0.8\,[25 - (-134)] = -102\ F = 358\ R$$

(b) Net work done in cycle is the difference between work done *on* air in compressor and work done *by* air turbine, or

$$W_{net} = \frac{1}{e_m}(h_{d'} - h_c) - e_m\,(h_a - h_{b'})$$
$$= \frac{c_p}{e_m}(T_{d'} - T_c) - e_m\,c_p\,(T_a - T_{b'})$$
$$= \frac{0.24}{0.98}(413 - 70) - 0.98 \times 0.24[25 - (-102)]$$
$$= 54\ \text{Btu/lb}$$

Refrigeration obtained in cycle is the heat addition process $b'c$ since heat added to refrigerant equals heat removed from cooled space. Therefore, refrigeration is

$$Q_A = h_c - h_{b'} = c_p\,(T_c - T_{b'})$$
$$= 0.24\ [70 - (-102)]$$
$$= 41.3\ \text{Btu/lb}$$

From Eq. (1), we have

$$\text{cop} = \frac{Q_A}{W_{net}} = \frac{41.3}{54} = 0.76$$

(c) Net power input to refrigeration is

$$\text{Power} = \frac{(150\ \text{lb/min})\ (49\ \text{Btu/lb})\ (60\ \text{min/hr})}{3413\ \text{Btu/kwh}}$$
$$= 129\ \text{kw}$$

ammonia absorption refrigerator

Simplified diagram of the *ammonia absorption refrigerator* is shown in Fig. 3. In the *generator*, a solution of ammonia in water is heated by a small gas flame. Ammonia is driven out of solution and ammonia vapor rises in the liquid lift tube. It carries some water with it much as water rises in the central tube of a coffee percolator. This water collects in the *separator*, from where it flows back through the absorber. Ammonia vapor, meanwhile, rises to the *condenser*. Ammonia vapor is liquefied here, its heat of condensation being removed by air circulating around the cooling vanes. Liquid ammonia then flows into the *evaporator*, in the cooling unit. It evaporates, absorbing heat from its sur-

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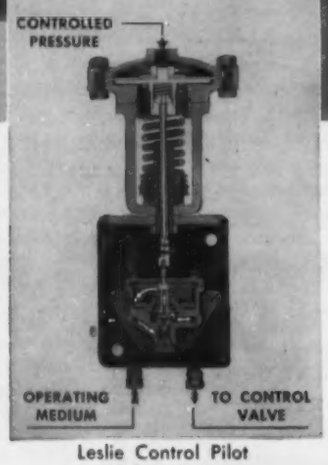

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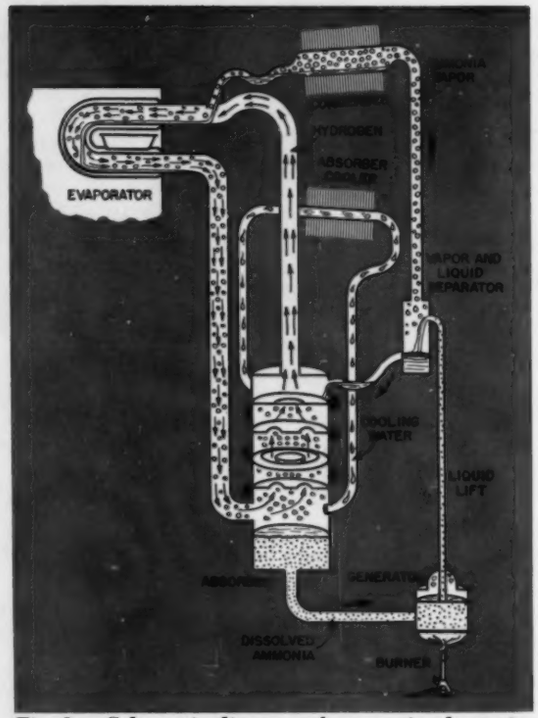

Fig. 3 — Schematic diagram of ammonia absorption refrigerator. No work is done on working substance.

roundings. Ammonia vapor continues on to the absorber, where it dissolves in water returning from the separator. Ammonia-water solution then flows to generator, completing the cycle.

Absorber and evaporator also contain hydrogen gas, which circulates by convection. This convection occurs because the mixture of ammonia and hydrogen in the extreme left tube is denser than pure hydrogen in the tube leading from the top of the absorber. This current of hydrogen, entering on top of the evaporator, sweeps ammonia vapor out of the evaporator and aids rapid evaporation. Since ammonia is much more soluble in water than hydrogen, most of the ammonia is dissolved in water trickling down through the absorber, while hydrogen passes upward through the absorber.

Heat must be removed from the absorber as well as from the condenser because heat is liberated when ammonia vapor dissolves in water. This is accomplished by an auxiliary circuit made up of cooling coils around the absorber and absorber cooler.

Working substance in an ammonia absorption refrigerator is completely enclosed in a rigid container. No work is done on it. Only interchange of energy is by a flow of heat. Heat is absorbed by the working substance in two different parts of the cycle (generator and evaporator). Heat is liberated in the condenser and in the absorber.

Let T_3 represent the temperature of generator, T_2 the temperature of condenser and absorber (assumed equal for simplicity), and T_1 the temperature of evaporator. Then $T_3 > T_2 > T_1$.

Consider an idealized reversible cycle in which a system absorbs heat Q_3 from a source at temperature T_3, absorbs heat Q_1 from a source at a temperature T_1, and rejects heat Q_2 to a sink at temperature T_2. This device is shown schematically in Fig. 4. From the First Law of Thermodynamics, considering all Q's as positive, heat rejected is

$$Q_1 + Q_3 = Q_2 \tag{4}$$

Since cycle is ideal, net change in entropy is zero by the Second Law. Entropy of reservoir at T_2 increases by Q_2/T_2. Entropy of other two reservoirs decreases by $Q_1/T_1 + Q_3/T_3$. Hence we have

$$\frac{Q_1}{T_1} + \frac{Q_3}{T_3} = \frac{Q_2}{T_2} \tag{5}$$

Coefficient of performance of this refrigerator is

$$\text{cop} = \frac{Q_1}{Q_3}$$

since Q_1, heat absorbed from the low-temperature reservoir (surroundings of evaporator) is "what we get." Heat Q_3 absorbed from the high-temperature reservoir (gas flame) is "what we pay for." Using Eqs. (4) and (5), we find

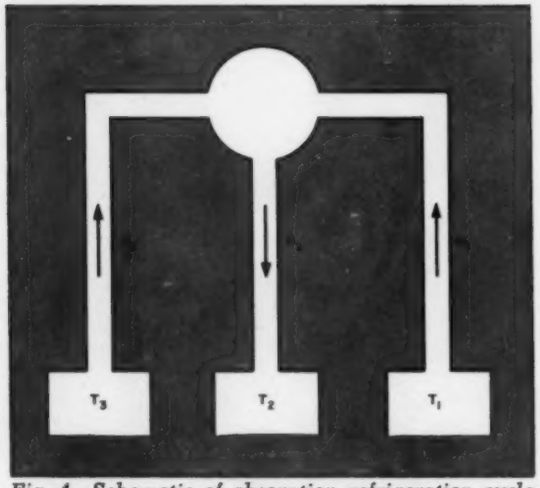

Fig. 4—Schematic of absorption refrigeration cycle processes which give lower performance coefficient.

$$\text{cop} = \frac{T_1\,(T_3 - T_2)}{T_3\,(T_2 - T_1)} \tag{6}$$

For example, if $T_1 = 14\text{ F} = 474\text{ R}$, $T_3 = 212\text{ F} = 672\text{ R}$, $T_2 = 68\text{ F} = 528\text{ R}$, then

$$\text{cop} = 1.88$$

This means that 1.88 Btu are absorbed in the evaporator for every Btu absorbed in the generator.

(continues on page 24)

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Coefficient of performance of actual refrigerator is, of course, smaller than this because of unavoidable irreversible processes.

Coefficient of performance of the ammonia absorption refrigerator is normally lower than those of mechanical refrigerators previously discussed. Remember that work input to a mechanical refrigerator has been obtained at the expense of irreversibilities and degradation of energy inherent in the conversion of heat into work.

properties of refrigerants

Refrigerant characteristics are as important as those of the working substance used in a heat engine. Desirable characteristics are:

- Pressure range corresponding to temperatures in the evaporator and condenser should be small, to reduce work of compression. Vapor pressure should be low to reduce condenser costs, but should be higher than atmospheric pressure to prevent air leaking into evaporator.
- Latent heat of vaporization should be large so that mass rate of flow of refrigerant will be low. Similarly, low heat capacity in the liquid phase reduces amount of vaporization in the throttling process and more heat is abstracted in the evaporator. Consequently, a reduction in mass rate of flow takes place.
- High heat transfer rates should be possible with reasonable heat transfer surface and temperature differences. One especially desirable characteristic is that the critical point be well above the highest temperature met in operation. Refrigerant entering condenser is then near the 2-phase region. Higher heat transfer rates in 2-phase region and more-nearly reversible isothermal heat transfer can be exploited in this way.
- Refrigerant should be low in cost, stable, inert, nontoxic, and must not freeze at lowest temperatures met in operation.

No refrigerant has all these characteristics. Each refrigerant requirement must be met with a view to its own application.

what are heat pumps?

Heat pumps are reversed power cycles. A refrigeration cycle may be considered a heat pump cycle when *intended* to heat a given space rather than to cool it. In a heat pump, the evaporator extracts heat from a large body of water, the atmosphere, deep wells, or the earth. Heat is rejected from the condenser at a sufficiently high temperature to be practical for heating (see Fig. 5). Analysis of the heat pump cycle is identical to that of the refrigerator. Note, however, that the heat pump does *not* operate on a reversed refrigeration cycle.

Coefficient of performance of a refrigerator was defined as the ratio of refrigeration, Q_A, to net work done on the refrigerant in the cycle. *Coefficient of performance of a heat pump* is the ratio of heat delivered to heated space, Q_R, to net work done on working substance in the cycle, or

$$\text{cop (heat pump)} = \frac{Q_R}{W_{net}} = \frac{Q_R}{Q_R - Q_A} \qquad (6)$$

Suppose that a practical value for the coefficient of performance of a heat pump is 4. Then the advantage of using a heat pump over electric energy as a source of heat is very nearly 4 times, since 4 units of heat are obtained for each equivalent unit of electric energy used to do work in the heat pump. Now, electric energy is obtained at the expense of irreversibilities in the power plant and distribution system. What possible advantage can exist over burning fuel directly as a source of heat? To answer this, remember that although the *expression* for heat pump coefficient of performance is the reciprocal of the *expression* for thermal efficiency of a heat engine, this is not necessarily true of the numerical values in these expressions. A power plant may operate with temperature differences between

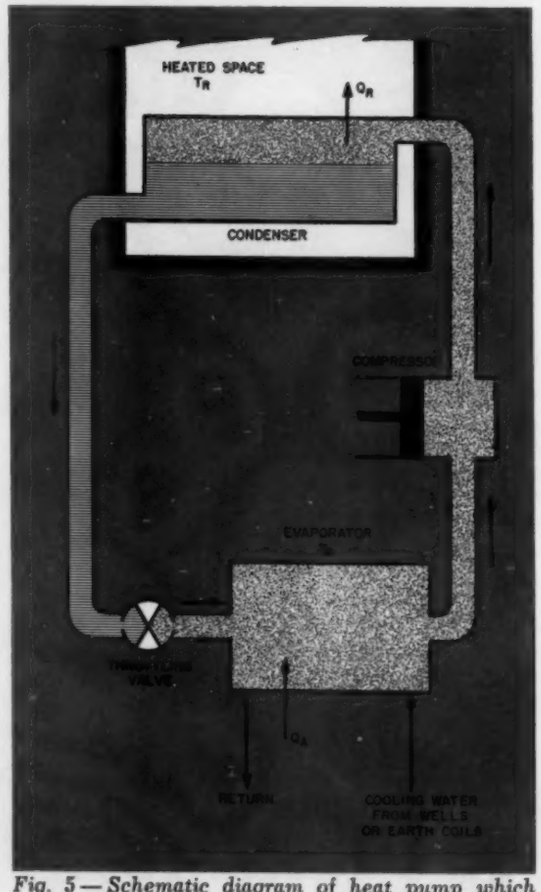

Fig. 5 — Schematic diagram of heat pump which does not operate on a reversed refrigeration cycle.

source and sink of 1000 F, or even more. But temperature differences for a heat pump may be more nearly 100 F.

Suppose that efficiency of energy conversion in the fuel to electric energy is about 27 percent and heat pump coefficient of performance is 4. Then for each unit of energy in the fuel supplied to the power plant, 1.08 units of heat are delivered by the heat pump.

To determine the economic advantage of the heat pump, consider the entire production cost of electric energy, in which fuel costs may not be the most important factor. It appears, at present, that the heat pump is economically advantageous only in moderate climates or where low-cost electric energy is available. ♦♦

What's new?

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Coal evaluation

. . . starts on page 16

Total losses, then, are the sum of lines 36 to 42. This vaue (12.06 percent) is entered on line 43.

Boiler efficiency is the difference between 100 percent and the total losses determined above. The value 87.94 percent is entered on line 44.

Heat added in boiler per pound of coal is the Btu per pound of coal multiplied by the boiler efficiency. (13,290) (.8794) = 11,687 Btu. This value is entered on line 45.

Steam evaporated per ton of coal is the heat added in the boiler per ton of coal divided by the heat picked up in the boiler by one pound of feedwater. We then have

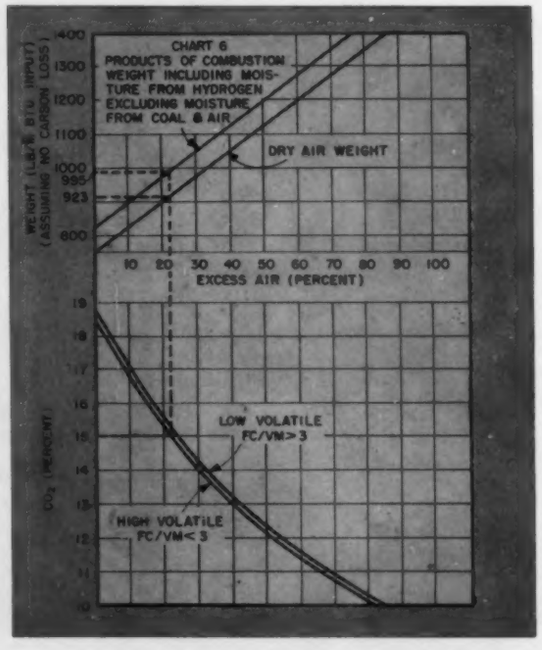
$$\frac{(2000)\ (\text{line } 45)}{\text{line } 30 - \text{line } 32} = \frac{(2000)\ (11{,}687)}{1409.7 - 198.2} =$$

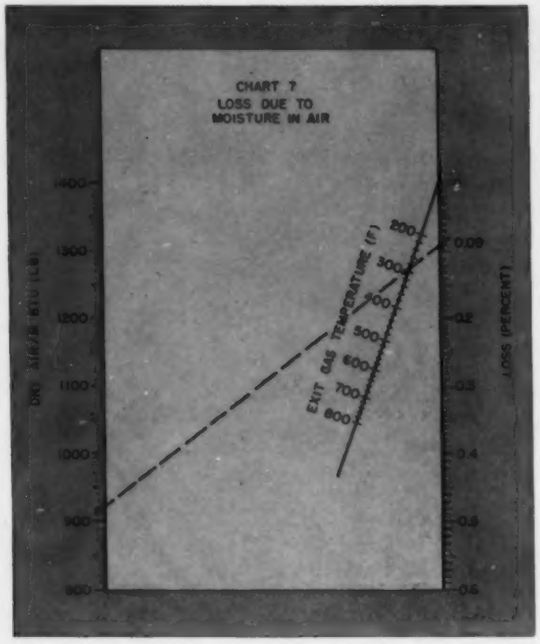
19,293 pounds, entered on line 46.

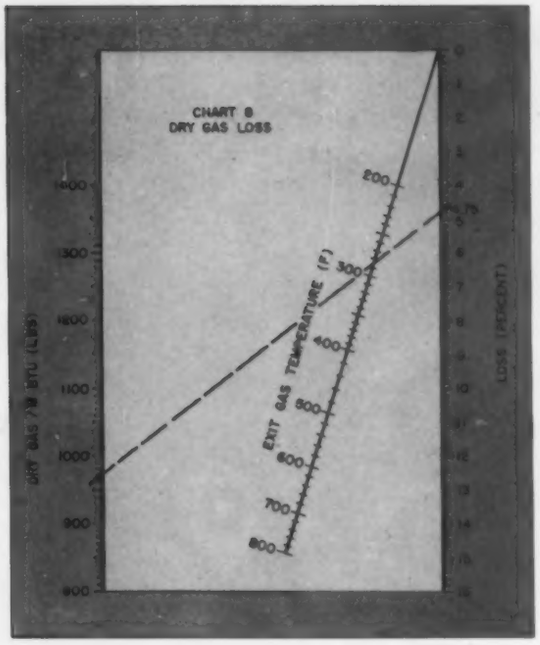
Cost per thousand pounds of steam with coal at $1.00 per ton is now obtained.

One ton of coal evaporates 19,293 pounds of steam. Coal required to evaporate 1000 pounds of steam is, therefore, $\frac{1}{19.293}$ tons. Multiplying this figure by $1.00 gives a cost of $0.0518 per thousand pounds of steam with coal at $1.00 per ton.

Coal cost per ton is obtained from the purchasing department and is entered on line 48 as $3.750. Freight cost per ton is obtained from the purchasing department and is entered on line 49 as $4.840. (This







cost includes Federal taxes, which can't be ignored.)

Coal handling cost per ton comprises electric power required to operate the car shaker, open feeder, belt conveyor, elevator, cross conveyor, bunker conveyor, magnetic separator, and coal crusher. Based on electricity at $0.005 per kwh, operating cost for this equipment is $0.001 per ton when crusher is bypassed and $0.003 per ton when the crusher is operating. Coal considered is carbon size and does not require crushing. Cost of $0.001 is entered on line 50.

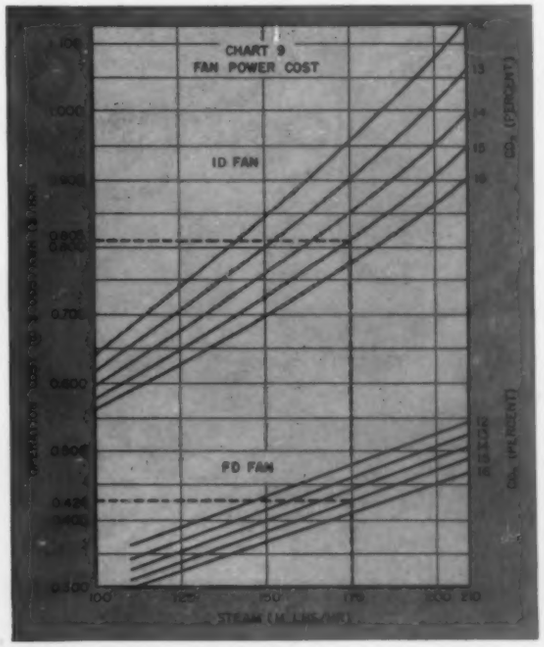
Ash handling cost comprises steam, water, compressed air, electricity, and trucking costs. It amounts to $0.343 per ton of ash. Since this coal contains 6.7-percent ash, the ash handling cost per ton of coal is (.067) (.343) = $0.023, which is entered on line 51.

now determine fan power cost

Induced-draft fan power cost is determined from Chart 9. Induced-draft fan power cost to evaporate 175,000 pounds of steam at 15-percent CO_2 is $0.805. For 19,293 pounds of steam (line 46) this will cost $\frac{(175{,}000)\ (.805)}{19{,}293} = \$0.073$. Enter this on line 52.

Forced-draft fan power cost is also determined from Chart 9. It is found that the forced-draft fan power cost to evaporate 175,000 pounds of steam at 15-percent CO_2 is $0.424. For 19,293 pounds of steam (from line 46) this will cost $\frac{(175{,}000)\ (.424)}{19{,}293} = \$0.038$. Enter this on line 53.

From line 46, it is found that 19,293 pounds of steam are generated per ton of coal. Quantity of coal required to generate 175,000 pounds of steam is $\frac{175{,}000}{19{,}293} = 9.07$ tons. Enter Chart 10 (page 28) at 9.07, proceed to the curve marked two pulverizers, then horizontally to index line and vertically to $0.67, (cost for 9.07 tons). This gives $\frac{0.67}{9.07} = \$0.074$ per ton. Adjust this cost for grindability and



Ever looked in your reference file for specific information when you needed it—and found a void. Or perhaps you found *some* material, but not the right kind. We *all* have. Well, here's a chance to be sure you have a *lot* of information on one subject, at least—heat processing.

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I-1

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SORGEL is the Name to Remember

When planning electrical distribution in industrial, commercial, and institutional buildings, keep in mind SORGEL dry-type transformers

Big savings . . .

can be made in the original installation cost by transmitting electric power and lighting current at higher voltages to load centers, then stepping it down to the utilization voltage with Sorgel dry-type transformers.

SORGEL transformers are so compact that they do not require much space, and can be installed in most any convenient or out-of-the-way place inside of buildings. They do not require fire-proof vaults nor enclosures.

SORGEL dry-type transformers are so quiet in operation that they are particularly adaptable for indoor installations — in hospitals, libraries, schools, institutions, office buildings, stores, and other structures where low sound levels are an important factor.

INCREASED EFFICIENCY — Installation close to the load centers results in shorter feeders, better voltage regulation, more efficient distribution, and lower wiring cost.

SAFE, LOW OPERATING TEMPERATURE.

LIBERAL DESIGN—Can safely carry an overload during an emergency.

EASY INSTALLATION — Attached mounting brackets.

EASY CONNECTING — Roomy connection compartment with solderless terminals.

LONG LIFE — Thermo-vacuum impregnated windings brazed to terminals.

UNDERWRITERS' APPROVED — SORGEL dry-type transformers are Underwriters' approved in all ratings covered by the Underwriters' Re-examination Service, both single phase and 3-phase.

A Perfect Partner for Substations

SORGEL transformers, either dry-type or Askarel-cooled, can also be incorporated in substations, complete with primary and secondary switchgear. They are procurable with any make of switchgear, and from any substation manufacturer.

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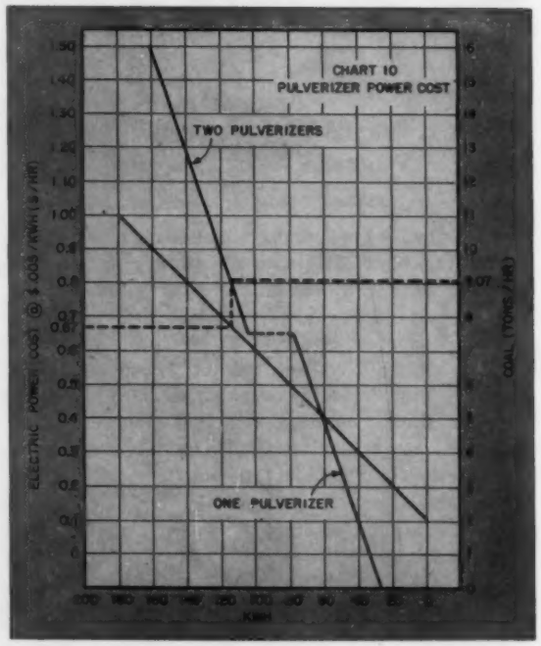
moisture content. Grindability, adjustment is made by referring to charts relating pulverizing cost to Hardgrove grindability and moisture content. The factor in this case is 0.937. ($0.074) (0.937) = $0.69. This is entered on line 54.

Adjusted cost per ton of coal is the total of lines 48 to 54 and equals $8.794.

Line 47 gives the cost per thousand pounds of steam with coal at $1.00 per ton. With coal at $8.794 per ton, this cost becomes, therefore, ($0.0518) (8.794) = $0.456.

This is the cost that should be compared with corresponding costs for competing coals. The coal showing the lowest steam cost per 1000 pounds is the coal that should be used. This cost does not include operating or maintenance costs and, therefore, does not represent the total steam cost. It does, however, represent that portion of the total cost that is affected by differences in coal quality and price.

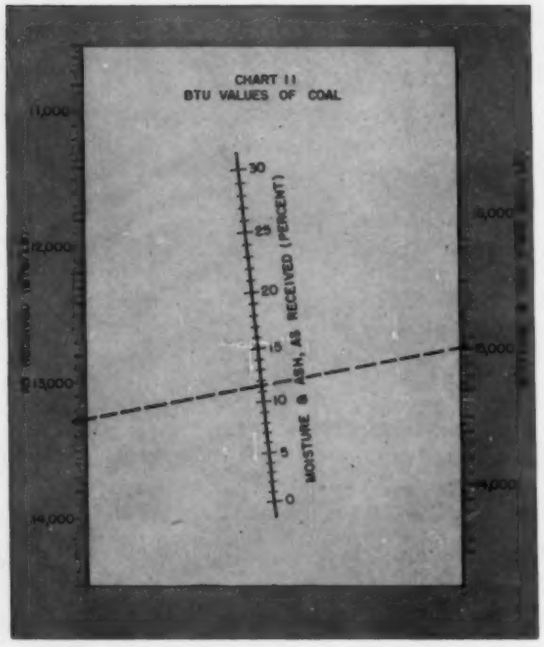


Based on KVP's operating conditions (Table I) and assuming that boilers operate 7000 hrs/yr, the saving for one boiler using various coals is as follows:

Coal	Steam cost per M pounds	Annual cost differential	Coal cost per M Btu
A	$0.436	$ 00	0.133
B	0.459	$28,175	0.142
C	0.460	$29,400	0.140
D	0.460	$29,400	0.133
E	0.470	$41,650	0.137
F	0.471	$42,875	0.140

Our laboratory is equipped to run proximate analyses. Grindability and ash-softening temperature are obtained from Bureau of Mines analyses that cover many mines from which our coal is shipped. If a particular mine is not covered, coal from the same seam and the same county can be found in these publications. Use these values in the calculations.

Chart 11 is used as a quick check on your laboratory tests before proceeding with calculations. It also can be used to verify vendor's data. Required data are the Btu content as received (Btu/lb), moisture content, and ash content. Comparison of these values on the nomograph with U.S. Bureau of Mines data should check within ± 1 percent.



Charts can be used with operating data as well as with assigned data. If preliminary evaluation indicates a coal is suitable and economically attractive, the coal should be burned and the evaluation repeated using operating data. When using operating data, boiler efficiency can be determined directly without calculating losses. Loss calculations may be made, however, to check the efficiency determined.

Evaluation should be repeated periodically from operating data for all coals purchased. This is done to determine whether the coal quality has deteriorated since the original evaluation to the point where it can no longer be considered an economical purchase. ♦♦

Write on company letterhead to Reader Service Dept. for reprints and more accurate working charts.

Your J-M Packings Distributor can tell you why this quality sheet packing has maintained such an excellent reputation for over 35 years

Where it's used: Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

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Your J-M Packings Distributor carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

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Which extras will pay off?

... starts on page 14

TABLE 1

SUMMARY OF CONSTRUCTION COSTS

Cost To Build	Oil-Fired	Coal-Fired	Coal and Oil
Boilers and auxiliaries	$ 240,000	$ 320,000	$ 335,000
Cost of erection	40,300	55,000	65,000
Feed pumps, in place	22,700	22,700	22,700
Deaerator, in place	12,800	12,800	12,800
Condensate pit and pumps	4,500	4,500	4,500
Feedwater treatment	15,400	15,400	15,400
Combustion and feed controls	34,200	34,200	34,200
Piping, valves, fittings	76,000	73,000	84,000
Stacks and breeching	18,100	24,300	24,300
Air compressor	6,600	6,600	6,600
Electrical	28,400	28,400	28,400
Blowoff pit	1,500	1,500	1,500
Building at 80¢/cu ft	77,000	102,000	102,000
Foundations at $50/cu yd	9,300	14,800	16,700
Oil tanks	27,000		12,000
Coal handling facilities		38,000	12,000
Pumps and heater set	12,000		12,000
Coal silos		18,600	18,600
Track hopper or oil unloader	600	800	1,400
Elevators and chutes		8,700	8,700
Bulldozer		7,800	77,800
TOTAL	$ 626,400	$ 789,100	$ 825,600
Plus 6% detailed design	37,500	47,300	49,500
Plus 10% profit	66,400	83,600	87,500
Plus 10% contingency	73,000	92,000	96,300
GRAND TOTAL	$ 803,300	1,012,000	1,058,900
Annual Fixed Charge*	$ 109,200	$ 137,600	$ 142,700

*Based on 10 year retirement @ 6 percent compound interest= (capital investment) (.1359)

SUMMARY OF ANNUAL OPERATING AND MAINTENANCE COSTS

Estimated annual steam export: 613 million pounds

	Oil-Fired	Coal-Fired	Coal and Oil
Fuel	$ 359,000	$ 266,000	$ 266,000
Fuel handling	6,000	23,000	19,000
Fuel inventory interest @ 6%	5,400	9,100	3,300
Operating labor	32,000	45,000	45,000
Maintenance labor	9,000	13,500	13,500
Maintenance material	7,000	11,000	12,000
Total annual operation	$ 418,400	$ 367,600	$ 358,800
Plus annual fixed charge	109,200	137,600	142,700
TOTAL ANNUAL COST TO OWN AND OPERATE	$ 527,600	$ 505,200	$ 501,500

Company "A"'s annual fixed charge would equal (.0736) (20,000) = $1472. Company "B" 's annual fixed charge would equal (.1359) (20,000) = $2718. Since Company "A"'s annual fixed charge is less than the saving to be realized, the turbine drives should be installed, whereas Company "B" should not install them.

determining economical capacity

Have sufficient installed capacity to handle your peak anticipated load. Firm capacity (one boiler out of service) should be sufficient to carry any essential load, if the loss of this load would exceed fixed charges to amortize the cost of the spare boiler capacity. This reasoning also applies to the size and number of auxiliaries.

Never just *assume* that you need or don't need that spare. Always figure what an unscheduled outage would cost in lost production, damage, and so on. Compare this with the annual fixed charge necessary to amortize the cost of the spare.

Consider, for instance, a spare boiler with auxiliaries and increased building size, foundations, piping, and so on that costs an extra $100,000. Cost of one anticipated 24-hour unscheduled outage per year would result in a $5000 loss. If your amortization and interest schedule were 10 years at 3-percent interest, that spare boiler should not be provided, because the $5000/year saving is less than the $11,720 annual fixed charge on the $100,000 investment.

When figuring the cost of an outage, always consider only the loss of your *least essential* load.

how to compare designs

Assume a plant with two 70,000 lb/hr boilers operating at 250 psig saturated steam, with average plant return and makeup temperature of 112 F. Should the boilers fire oil, coal, or combination coal and oil?

Assume that your company amortizes all capital expenditures in 10 years at 6-percent interest (factor 0.1359). No. 6 fuel oil costs $2.50/barrel. Delivered coal costs $7.00/ton for 12,540 Btu/lb coal as received (13,500 Btu/lb dry with 7-percent moisture). Average "yearound" overall coal-plant expected efficiency is 72 percent. Average overall oil-plant expected efficiency is 76 percent. Fuel supply problems require storage for a 6-month supply of coal (if capable of burning coal only), a 90-day supply of oil (if capable of firing oil only), and a 30-day supply of oil and of coal for a combination-fired plant. Typical tabulation of the relative economics of the three types of plant is shown in Table 1 for a 140,000 lb/hr plant expandable to 210,000 lb/hr.

In this case, the combination coal-oil fired plant should be constructed. It represents the lowest annual cost to own and operate, and has intangible advantages of flexibility, plus insurance against fuel strikes, and so on.

Combination coal-oil plant fires coal except in

ANNUAL FIXED CHARGE PER DOLLAR OF INITIAL INVESTMENT
(Multiply initial installation cost by factor to obtain annual fixed charge)

YEARS TO AMORTIZE	INTEREST RATE 2	2½	3	3½	4	4½	5	6	7
2	.5150	.5188	.5226	.5264	.5302	.5340	.5378	.5454	.5531
3	.3467	.3501	.3535	.3569	.3603	.3638	.3672	.3741	.3810
4	.2626	.2658	.2690	.2722	.2755	.2787	.2820	.2886	.2952
5	.2122	.2152	.2183	.2215	.2246	.2278	.2310	.2374	.2439
6	.1785	.1815	.1846	.1877	.1908	.1939	.1970	.2034	.2098
7	.1545	.1575	.1605	.1635	.1666	.1697	.1728	.1791	.1855
8	.1365	.1395	.1425	.1455	.1485	.1516	.1547	.1610	.1675
9	.1225	.1255	.1284	.1314	.1345	.1376	.1407	.1470	.1535
10	.1113	.1143	.1172	.1202	.1233	.1264	.1295	.1359	.1424
11	.1022	.1051	.1081	.1111	.1141	.1172	.1204	.1268	.1334
12	.0946	.0975	.1005	.1035	.1065	.1097	.1128	.1193	.1259
13	.0881	.0910	.0940	.0971	.1001	.1033	.1065	.1130	.1196
14	.0826	.0855	.0885	.0916	.0947	.0978	.1010	.1076	.1143
15	.0778	.0808	.0838	.0868	.0899	.0931	.0963	.1030	.1098
16	.0736	.0766	.0796	.0827	.0858	.0890	.0923	.0989	.1059
17	.0700	.0729	.0759	.0790	.0822	.0854	.0887	.0954	.1024
18	.0667	.0697	.0727	.0758	.0790	.0822	.0855	.0924	.0994
19	.0638	.0668	.0698	.0729	.0761	.0794	.0827	.0896	.0967
20	.0612	.0641	.0672	.0704	.0736	.0769	.0802	.0872	.0944
25	.0512	.0543	.0574	.0607	.0640	.0674	.0709	.0782	.0858
30	.0446	.0478	.0510	.0544	.0578	.0614	.0650	.0726	.0806
40	.0366	.0398	.0433	.0468	.0505	.0543	.0583	.0665	.0747

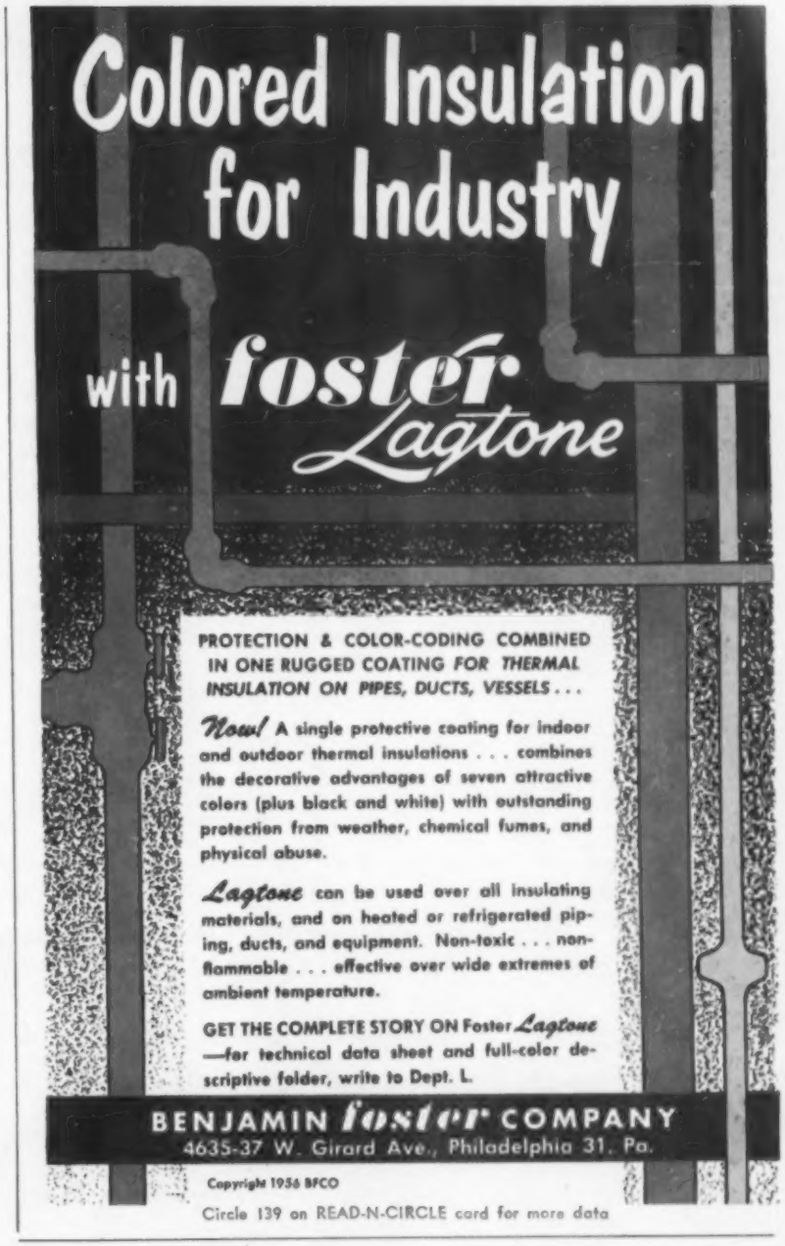
This annuity table gives factors by which investments must be multiplied to find the annual fixed charges that are applicable against the new equipment.

emergency. Fuel quantity calculations are made with Fuel Target chart, Page 14, INDUSTRY POWER, July 1956. To determine expected boiler plant efficiency, a heat balance is recommended for expected average load or series of typical loads. If time does not permit this more accurate method, boiler manufacturer's efficiency guarantees for *average anticipated load conditions* may be used with these rule-of-thumb deductions (subtract from boiler manufacturer's guaranteed efficiency):

Loss Item	Percentage Deduction
Boiler blowdown	% blowdown ÷ 4
Sootblowing, oil	1.0
Sootblowing, coal	2.0
Banking and startup	1.0 – 2.0
Leakage, radiation	1.0 – 3.0
Steam atomized oil burners	1.5

Having decided which plant shall be constructed, consider any additional equipment over and above the basic plant and similar economic bases. Consider, for example, installing air preheaters. Boiler manufacturer may indicate that a 4-percent efficiency gain is expected if a preheater were included with the boiler. This would cost $56,000 more. Additional annual fixed charges would be $56,000 x .1359 = $7600. The $266,000 annual coal bill at 72-percent plant efficiency would be reduced to $252,000 at 76-percent plant efficiency. Additional maintenance and fan power is estimated at $2500/year. Since the fixed charge plus additional maintenance and electric power costs ($10,100) are less than the fuel savings ($14,000), the preheaters should be installed.

Remember, a boiler plant cannot be designed on rules of thumb or abstract judgments without excessive investment or operating costs. Insure yourself of the lowest plant cost — building and operating costs together. COMPARE THE ECONOMY OF ALL POSSIBLE COMBINATIONS *BEFORE* YOU DESIGN AND BUILD YOUR PLANT. ♦ ♦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Cable trough

. . . starts on page 12

confusion reduced during installation, but the trough permits a number of cables to be delivered to a point at a control panel or a distribution center, where conduit simply would not fit.

Space saving contributes to the flexibility possible with cable trough. Turns, dropouts, and side runs are readily accommodated with our trough system. Conduit system rigidity simply does not permit such simplicity. Flexible design and space saving of trough also lend neat appearance to the finished job.

trough for power and control cables

Since we used trough as a support for power as well as control cables, we are, of course, concerned with electric characteristics. Our installation convinces me that trough provides a continuous metallic contact that, if grounded at intervals, gives a safe system virtually certain to activate circuit-breakers should a fault occur. I understand that barrier strips are available to separate power cables from control cables. We did not feel, however, that these strips were necessary.

Most important is the increased power cable efficiency attained when laid in trough as compared to the same cable when pulled through conduit. Since the trough contains less steel, there is less inductive loss carrying alternating current. Heat generated in a cable, moreover, is quickly dissipated by air circulating through and around the expanded-metal trough. These factors result in longer insulation life and substantially higher current-carrying capacity with advantage of economic operation.

trough makes inspection easy

A single layer of cable in expanded-metal trough conservatively can be allowed its free-air rating. Even with two layers of power cable, free-air ratings are probably safe.

Finally, we like the availability of the cable in trough for inspection, maintenance, repair, and tracing. We never know what insulation condition might be when cable is enclosed in conduit. If it should deteriorate in trough, we can replace the cable without damage to the wiring system. In conduit, we must simply wait for a fault. Should a fault occur in a trough system, repair is a simple matter. The same fault in a conduit system would result in loss of all the cable, since splicing is impractical. We also were grateful for a trough system after the initial installation had been completed. Tracing and some cable rerouting was necessary while work continued.

We had a fine opportunity at Jersey Central to compare the advantages of trough and conduit. We have more cable supported in conduit. Yet the convenience and economy of expanded-metal cable trough so far outweigh the possible advantages of conduit that we probably will use trough in future expansions. Certainly, I would recommend that others at least consider its possibilities. ♦ ♦

Typical installation shows how changes in direction and elevation can be made easily with cable trough.

Cable trough was supplied by T. J. Cope Company, Dept. IP, 713 South 50th Street, Philadelphia, Pa. For more information, circle 742 on READ-N-CIRCLE card on page 47.

TABLE I

COMPARISON OF PERMISSIBLE CABLE SIZES (SAME INSULATION) AT CONSTANT CURRENT AT 30 C AMBIENT

Current (amps)	Conduit (Maximum rating based on 3 cables or less)	Expanded metal cable trough (double cable layer)	Expanded metal cable trough (single cable layer)
300	500 MCM	300 MCM	000 MCM
400	750 MCM	450 MCM	350 MCM
500	1500 MCM	625 MCM	500 MCM

TABLE II

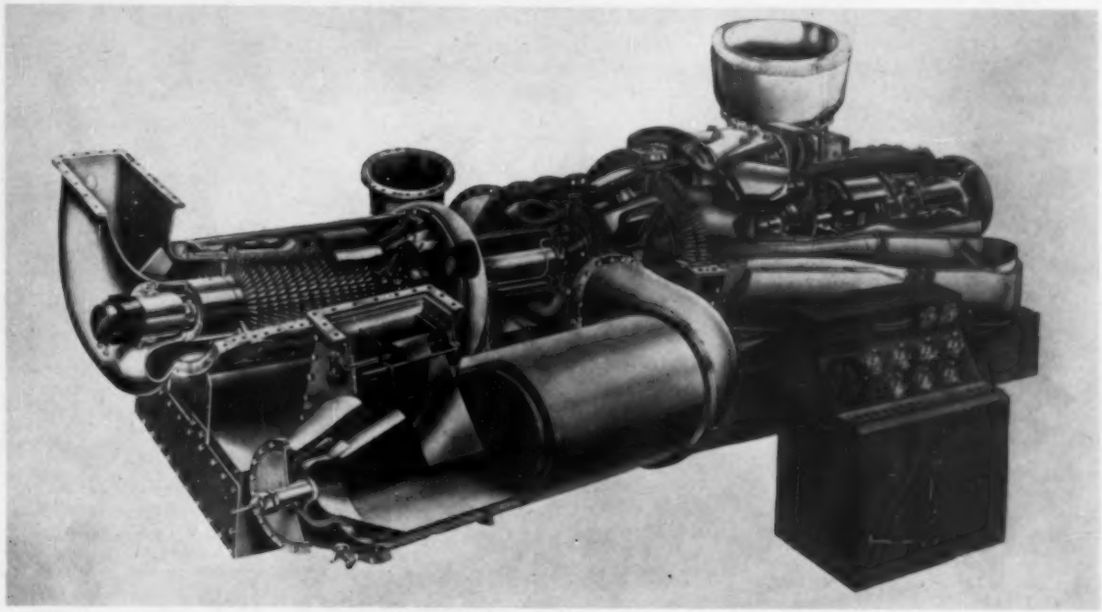
COMPARISON OF CABLE CURRENT RATINGS (SAME INSULATION) AT CONSTANT CABLE SIZE AT 30 C AMBIENT

Cable size	Conduit (Maximum rating based on 3 cables or less)	Expanded metal cable trough (double cable layer)	Expanded metal cable trough (single cable layer)
000	195 Amps	240 Amps	300 Amps
300 MCM	240 Amps	300 Amps	375 Amps
600 MCM	355 Amps	460 Amps	575 Amps
1000 MCM	455 Amps	625 Amps	780 Amps
2000 MCM	560 Amps	925 Amps	1155 Amps

That's what I like about aluminum-sheathed cable —so flexible!

new products

. . . just circle key numbers on READ-N-CIRCLE card on pages 47 or 48



700-Gas turbine accepts full load within two minutes

Lightweight gas turbine accelerates to 6000-rpm design speed within two minutes. Mark TA turbine gives industrial users a new, modern prime mover. Its light weight and small size permit use in locations where heavier units cannot be easily installed. Complete turbine weighs approximately six tons.

Turbine operates on a simple, open cycle. It is a dual

shaft, series-flow unit developing 1130 bhp at 80 F and 1000 feet. Output speeds of 1500 and 1800 rpm can be obtained by using built-in planetary gears. Unit embodies features of single combustion chamber, air-cooling, long life, and easy accessibility for maintenance and inspection of all parts.

Combustion air is supplied by a 13-stage axial-flow compressor at a pressure ratio of 4.0:1 and flow of approximately 22 lb/sec. Compressor is driven through a flexible coupling at 11,500 rpm. Compressor case is split on horizontal center-line to permit easy access. Fuel combustion is accomplished in a single, elbow-type combustion chamber with a single burner.

Turbine consists of high- and low-pressure units. Two-stage high-pressure unit operates at a speed of 11,500 rpm. Two-stage low-pressure unit operates at 6000 rpm. Turbine blades are unshrouded and designed on the free-vortex principle. This assures high component efficiency with constant axial-flow velocity and uniform loading over entire blade section. Turbine is designed for normal operation at inlet temperature of 1340 F. Compressor and turbine rotor are dynamically balanced. Turning gear is not required for cooling the unit after shutdown.

A 30-hp starter motor and 2½-hp auxiliary motor (for fuel oil and lubricating pumps) are powered by a 24-volt battery system. Batteries are charged automatically from 440-volt, 3-phase, 60-cycle ac supply.

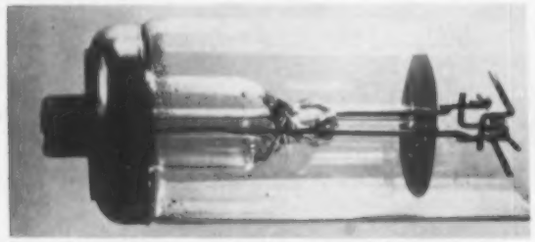
Unit is started by turning a single hand wheel. Compressor is started initially by 24-volt dc starter motor. Burner is then ignited and compressor is brought up to speed of 5000 rpm. Starting motor automatically disengages at this speed. Compressor and high-pressure turbine continue to accelerate to idling speed (6000 rpm). Governor starts operating at 6000 rpm. Lubrication and fuel oil (where necessary) are supplied by auxiliary dc motor-driven pumps during startup. Pumps automatically shut off when control wheel is set in running position. At this speed, engine-driven auxiliaries automatically take over.

Centrifugally controlled hydraulic governor controls speed. With a load increase equal to 25 percent of full load, transient speed variation is held within 5 percent.

Unit is well suited to processes where turbine exhaust energy can be used for preheating or steam generation. CLARK BROS. CO.

701-Lamp gives 2½ times more light

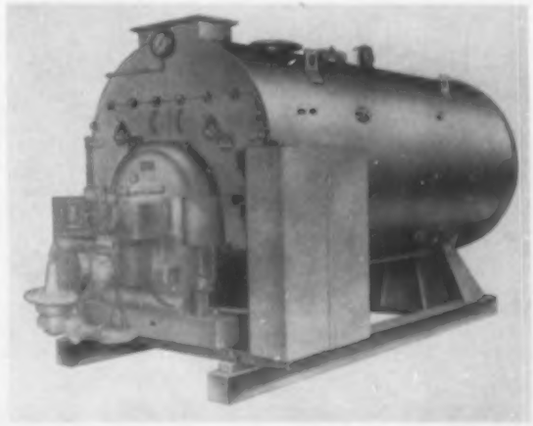
Fluorescent lamp for universal application provides 2½ times as much light as conventional lamps. Outstanding features of newest lamp development are: More efficient lamp diameter, rapid start continuous filament heating, "pressure control" center, and use of neon instead of argon gas. Space is saved and initial cost is



reduced by obtaining the same light intensity with two new fluorescent lamps instead of four conventional lamps. High-bay industrial lighting as well as low-bay and medium-bay industrial lighting are immediate fields of use. Neon gas, under special pressure and temperature conditions, is superior to argon gas and materially aids high light output. SYLVANIA ELECTRIC PRODUCTS INC.

702-Scotch-type boilers in 26 sizes

Scotch-type heating boilers using natural or forced-draft gas or oil burners are available in 26 sizes. Thirteen sizes are available employing natural draft. SBI steam ratings extend from 4500 to 35,000 sq ft. Thirteen sizes are available with forced draft oil, gas, or gas-oil



firing. SBI steam ratings range from 6440 to 50,000 sq. ft. All units feature rear combustion chamber completely surrounded by water-backed heating surface. Construction improves performance, reduces heat escape to boiler room, and eliminates refractories. HEATING AND AIR-CONDITIONING DIVISION, NATIONAL-U.S. RADIATOR CORPORATION.

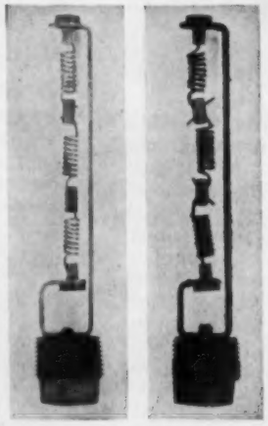
(more new products on page 34)

BIRD-ARCHER Amine Treatment
INSURES LONGER LIFE FOR PIPE

Return line corrosion is one of the most critical problems in maintaining economical, efficient power plant operation.

Bird-Archer Amine Treatment is an easy, effective and economical way to eliminate corrosion troubles. Amines raise the pH value of the return condensate to the point whereby the corrosion potential is negative. In addition, amines provide a surface protection for the metal itself which further inhibits corrosion. In scores of plants, Bird-Archer Amine Treatment is paying a profit on its cost through savings in piping replacement and maintenance work.

To demonstrate what corrosion can do in steam and condensate return lines, we show here "before" and "after" unretouched photographs of NDHA Corrosion Testers. This is a test* developed by the American Society for Testing Materials in cooperation with the National District Heating Association. Bird-Archer supplies and analyzes these testers. Photo at left shows a Tester before installation. Photo at right shows a Tester after it had been installed for 60 days in the return line. (*Standard Method of Corrosivity Test of Industrial Water, NDHA Method, ASTM Designation 935-49.)



Write for BULLETIN CP-100 AND THE NAME OF THE BIRD-ARCHER SERVICE ENGINEER NEAREST YOU.

Send for Catalog on Bird-Archer Proportioning Pumps

BA 602

BIRD-ARCHER
WATER TREATING ENGINEERS
THE BIRD ARCHER COMPANY, 4337 N. AMERICAN ST., PHILADELPHIA 40, PA.
New York, Chicago
The Bird-Archer Co. of California, 881 Mission St., San Francisco
Offices also in Canada and Mexico

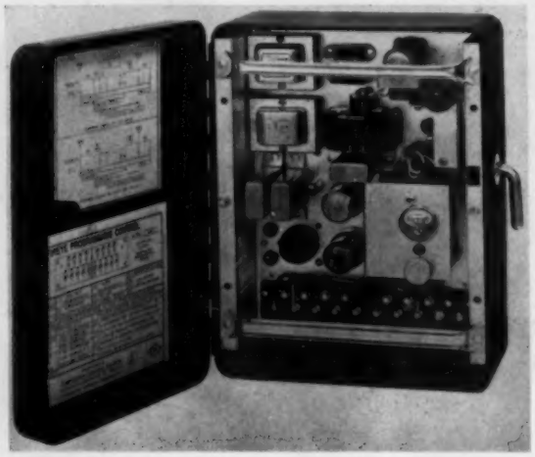
Circle 149 on READ-N-CIRCLE card for more data

new products

. . . starts on page 33

703-Control guards operating sequence

Primary control programs and safeguards entire operating sequence of fully automatic rotary oil and gas burners. Unit uses two flame-sensitive scanners. One scanner monitors pilot flame and supervises ignition sequence. Second scanner safeguards the main flame.



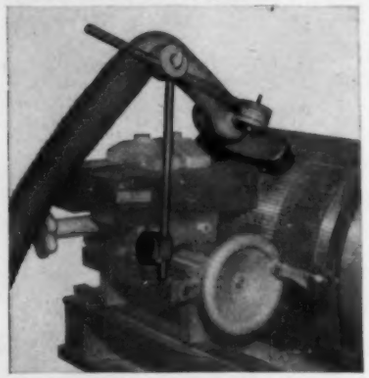
System provides for pre-purge, pilot proving, limited trial-for-ignition, and post-purge periods. Fuel is shut off within one second if flame failure occurs during start up or operating periods. ELECTRONICS CORPORATION OF AMERICA.

704-Portable forced-air space heater uses plug-in source

Portable forced-air space heater gives completely automatic operation. Only 16-inches wide and 40-inches long, it plugs into any 115-volt ac outlet. Unit will operate up to 12 hours with one fueling of No. 1 or No. 2

fuel oil or kerosene. Unit delivers 120,000 Btu/hr at 950 cfm. Unit can be equipped with flexible ducts for directing heated air flow to selected areas without heat loss. CLAYTON MANUFACTURING CO.

an IDEAL idea...
DUSTLESS COMMUTATOR GRINDING!



Vacuum attachment picks up metal and stone dust as it is made . . . keeps it out of machine

- **Compact and simple, it does NOT interfere with work in progress.**
- **Fits all IDEAL industrial vacuum cleaner hoses; mounts on grinder or on motor or generator frame.**
- **Cuts clean-up time, prevents bearing trouble and hard-to-locate short circuits.**

Model No. 24-073 is for small commutators; mounts on Ideal's "Midget" Model Grinder or motor or generator frame. Stationary nozzle covers entire commutator.

Model No. 24-074 mounts on Ideal's "Perfect" or "Ideal" Model Grinder, traverses large commutators with the grinder.

Write for more information on these handy attachments. When writing, also ask for IDEAL's informative series of articles on "Commutator and Slip Ring Maintenance."

IDEAL INDUSTRIES, INC. (IDEAL)
1023 Park Avenue, Sycamore, Illinois

☐ Send more data on vacuum attachment described in this ad.

☐ Add my name to your mailing list for FREE "Commutator & Slip Ring Maintenance" articles.

Name_____

Company_____

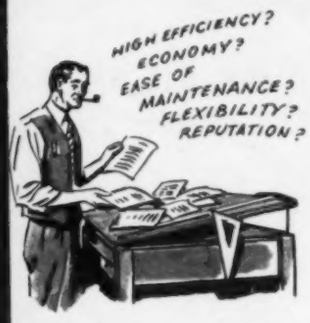
Address_____

City_____ Zone____ State_____

Circle 132 on READ-N-CIRCLE card

SCHNEIBLE

What are you looking for in a Dust Collector?



Then, you're looking for a Schneible Multi-Wash Collector

Schneible Multi-Wash Collectors are the most efficient wet collectors on the market today. Reports by outside analysts are available for your study on request.

Recent improvements in design and application make the Schneible Collector an even more economical unit. Write for our new literature incorporating these improved features.

There are no moving parts in Multi-Wash Collectors, no spray nozzles to plug, nothing to freeze, and flushing with a fire hose once a month gives you many years of maintenance-free service.

Flexibility? Yes, and at any time in the future extra sections can be added to further increase the efficiency.

The Claude B. Schneible Company has been the leader in the wet collection field for more than two decades.

Write today for more information.

SCHNEIBLE

Claude B. Schneible Co.
P.O. Box 81, North End Station
Detroit 2, Michigan • Phone TYler 5-8212

Name_____
Title_____
Company_____
Address_____
City_____
Zone____ State_____

SERVING INDUSTRY THE WORLD OVER

Circle 100 on READ-N-CIRCLE card

705-Here's economy size control console

Economy size single-channel control console for industrial sound systems measures only 22-inches wide and can be desk-mounted. Unit provides facilities for communicating with up to 16 rooms. Incorporates a program or input source for distributing entertainment

or educational programs from radio, tape recorder, phonograph records, or combination monitor-microphone. Features a 10-watt amplifier with frequency range of 50 to 15,000 cps, a balanced 70-volt output, and low impedance. RADIO CORPORATION OF AMERICA.

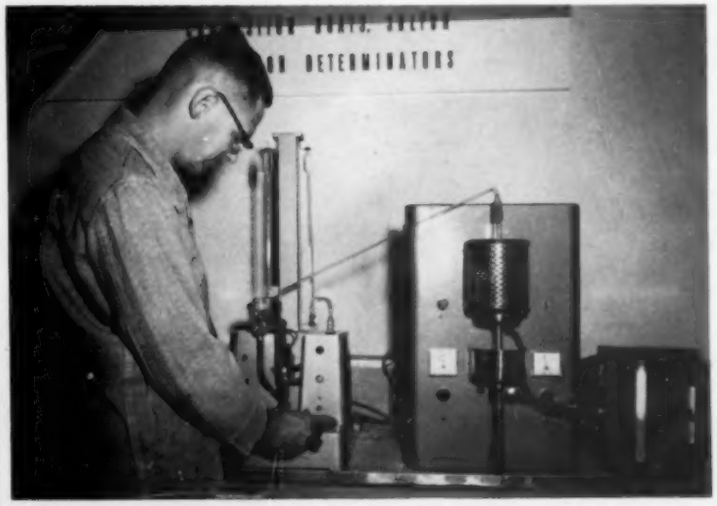
MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 47 or 48.

706-How to get sulfur content of coal

This new method rapidly determines sulphur content in coke and coal. Equipment uses electric induction furnace and automatic titrator. Analysis time is approximately 5½ minutes compared with one to six hours using conventional bomb procedure. Automatic titrator relieves operator for other analysis during combustion period.

Procedure uses colorless indicator solution containing starch, HCl, and

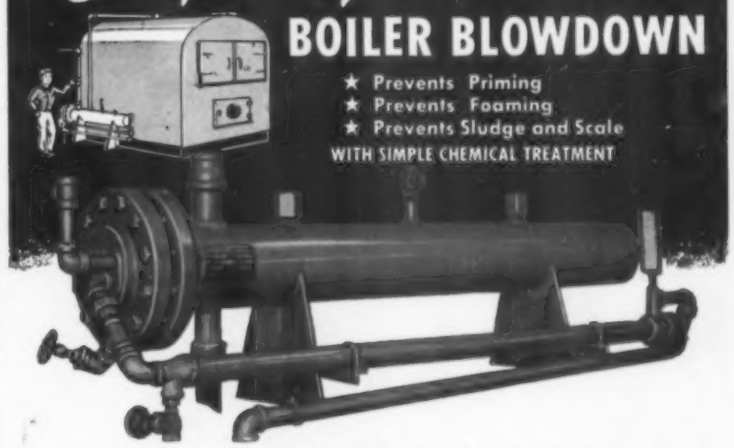


KI. Sulphur dioxide from combustion bubbles through starch-KI indicator solution. Titrant solution, containing KI, KIO_3, and KOH is automatically controlled by photoelectric cell to keep solution colorless. Simple calculation gives percent sulphur in sample. Accuracy is within ±1 percent of conventional bomb method. LABORATORY EQUIPMENT CORPORATION.

(more new products on page 36)

Completely Automatic BOILER BLOWDOWN

★ Prevents Priming
★ Prevents Foaming
★ Prevents Sludge and Scale
WITH SIMPLE CHEMICAL TREATMENT



USED BY STOKELY-VAN CAMP

at their Beaver Dam, Wisconsin Cannery to insure absolute, automatic control of boiler water concentration. This compact, self-contained unit was easily and quickly installed by their own maintenance men.

Automatic control is assured *without heat loss* regardless of boiler load.

For further information write . . .

Our field engineers will call at your plant on your request.

HENSZEY

HENSZEY COMPANY
Dept. A, Watertown, Wisconsin

Circle 109 on READ-N-CIRCLE card for more data

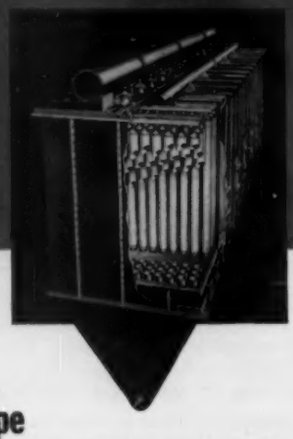
I don't care if you do use blowoff steam, it must go!

It's so easy to enter the Power Show Contest

Just think for a moment how your company would profit by your attending the 1956 Power Show to be held in New York, November 26 to 30. Then fill out the entry blank on page 8, and drop it in the mail. You may win yourself a free trip plus expenses.

Dust and Fume Collection by Norblo

helps you achieve efficiency and cleanliness in your plant



Norblo has developed bag type dust collection systems to a high degree of efficiency.

Norblo Automatic Bag Type

For continuous and heavy duty service at constant capacity and efficiency, Norblo Automatic Bag Type collection pays its own way — in recovery of valuable materials or removal of injurious or "nuisance" industrial air contaminants. Norblo builds the entire installation, from blowers to bag-cleaning mechanisms. Complete systems are engineered to meet specific situations. Norblo engineering insures low maintenance and no shut-downs — guarantees performance of every installation.

Norblo Standard Bag Type Collectors

Based on the same construction principles, the standard bag type collectors provide at low cost the high efficiency service that is obtainable only from bag-type cloth filtering, with either compressed air or electrically driven periodical bag shaking and cleaning. Units must be shut down for cleaning — at such times as the noon hour and end of working day.

Norblo Portable Type

For excellent results in localized dust control, Norblo Portables protect equipment and reduce maintenance in grinding, polishing and cutting departments. Six models cover capacities from 300 to 1350 cfm., at 8" static pressure at the fan. Occupy small space. Are unusually quiet.

Write for bulletins describing Norblo bag type dust collectors.

The Northern Blower Company

6422 Barberton Ave., Cleveland 2, Ohio • OLympic 1-1300

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

Circle 101 on READ-N-CIRCLE card for more data

new products

. . . starts on page 33

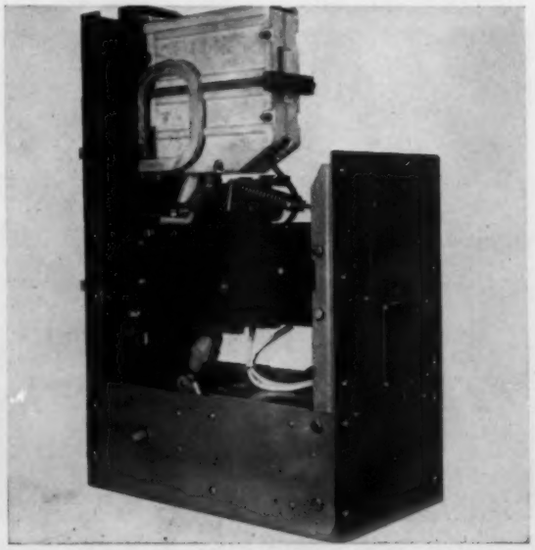
707-Use power for cleaning drains

New power drain-cleaning machines are designed for industrial and institutional maintenance on drain lines from ¾-inch to 3-inch diameter. Unit is powered with a ⅛-hp repulsion-induction motor. Adapter holds

up to 25 feet of ¼-inch cable, which can be interchanged with as much as 100 feet of ⅝-inch cable to extend machine's range. Unit is extremely compact and is easily moved to any trouble spot in the plant and can be operated by one man. KOLLMANN MANUFACTURING COMPANY.

708-Circuit breaker operates in a hurry

New current-limiting high-speed dc circuit breaker will operate continuously at 1000 volts and 1200 amperes. FB-12 breaker is designed for extremely fast tripping

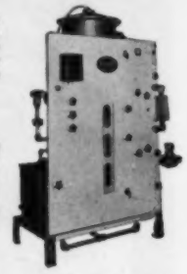


and fault current interruption. It will completely interrupt current in a total of 0.012 seconds, and limit current magnitude in 0.004 seconds. Primary applications are for generator and driving motor protection. I-T-E CIRCUIT BREAKER COMPANY.

ILLCO-WAY ionXchange

"PACKAGED" DE-IONIZERS

Right, standardized Model MB Mixed-Bed De-Ionizer available in four sizes for maximum flow rates ranging from 150 to 1000 gals. per hr.



Left, typical Model LU or HB Two-Bed De-Ionizer, each series made in six sizes covering maximum flow rates ranging from 150 to 1000 gals. per hr.

COMPLETELY ASSEMBLED AND TESTED AT FACTORY

If you can determine the capacity and flow rate you need, you can pick out a *ready-made* ILLCO-WAY unit that is all set to be hooked into your lines and go to work. Three series of models are designed to provide different degrees of water purification and different types of treatment, as required by individual situations. All models and sizes have been thoroughly time-tested and have proved highly satisfactory in hundreds of installations.

READY TO OPERATE AS SOON AS CONNECTED

Each one of these "packaged" De-Ionizers is assembled at the factory, the resins put in the tanks, and the completed unit given a working test. Then, without dismantling in any way, it is crated, and is ready for shipment. *For full details and specifications, write . . .*

ILLINOIS WATER TREATMENT CO.
ionXchange
ILLCO-WAY
840 CEDAR ST.
ROCKFORD, ILLINOIS

NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N.Y.
CANADIAN DIST: PUMPS & SOFTENERS, LTD. LONDON, ONT.

Circle 147 on READ-N-CIRCLE card

What's your need for heat?

Whatever your heating job may be, you'll find the efficient, economical answer in . . .

CHROMALOX Electric Heaters

. . . for heating platens, dies, molds, metal parts . . . for heating liquids, air, gases . . . for curing, drying, baking . . . for comfort heating in offices and factories . . . for special applications . . . in fact for any application requiring fast, low-cost, controlled heat up to 1100°F.

IMMEDIATE DELIVERY

from the world's largest factory stock of industrial electric heaters . . . over 15,000 types, sizes and ratings.

Let the Chromalox Sales-Engineering staff solve your heating problems . . . electrically.

Write for your copy of Catalog 50

Contains helpful information on design uses, and prices of Chromalox Electric heaters, elements, thermostats, contactors and switches.

To get some interesting facts about additional applications of electric heat, ask for Booklet F1550—"101 Ways to Apply Electric Heat."

Edwin L. Wiegand Company

7520 Thomas Boulevard, Pittsburgh 8, Pennsylvania

EDWIN L. WIEGAND COMPANY
7520 Thomas Boulevard, Pittsburgh 8, Pa.

I would like to have—

☐ A copy of Catalog 50
☐ A copy of "101 Ways"
☐ A Sales-Engineer contact me

Name_____

Company_____

Street_____

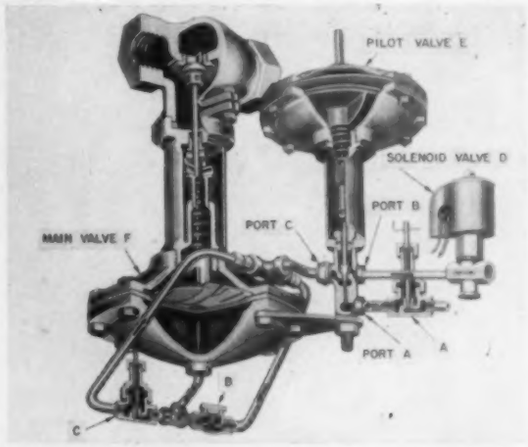
City_____ Zone____ State_____

A-4485A

Circle 116 on READ-N-CIRCLE card

709-Control valve saves money

Adroit selection of control valves in low-pressure steam heating system saves up to 50 percent on equipment costs. Basic unit uses standard pilot-operated pressure reducing valve with added solenoid valve in



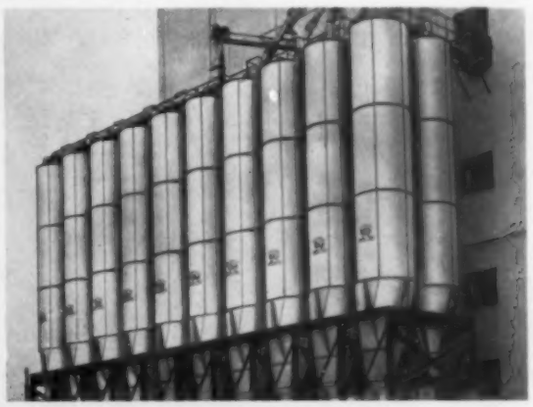
exhaust line of pressure-pilot valve. System gives excellent control. Functions as both pressure regulator and motorized valve. Equipment cost is less than for separate pressure-regulating valve and motorized valve. C. E. Squires Co.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 47 or 48.

710-Baffles prevent bin bridging

Cable-suspended discs keep products free-flowing in these bulk storage bins. Discs are strategically located in the bin to aid material flow and prevent bridging. Bins are field-erected by merely bolting standard sections together. Additional capacity can be



obtained by adding extra sections. Storage bins are available in sizes from 3- to 14-feet diameter and up to 100-feet high. Twin screw feeders, air lock rotary valves, rack and pinion gates, or other discharge accessories are available. The Day Company.

(more new products on page 38)

Handling 12,000 Tons of Coal Daily with NO DUST

Close-up of J-M system in action at car dumper

Giant Power Plant controls dust at...

- **Rotary Car Dumper and Shakeout**
- **Barge Unloader**
- **Crusher Area**
- **Conveyor Transfer Points**

J-M dust control equipment was installed because of its high effectiveness and unusual flexibility of application. This is only one of many examples of how a Johnson-March system effectively solves dust problems for power stations and industrial plants.

J-M Dust Control costs only 1/10 as much!

No costly ducts, hoods, or fans. Almost no maintenance. An economical Johnson-March system can eliminate fire and explosion hazards, community dust nuisance, safety hazards, and maintenance problems. Even the efficiency of existing mechanical dust collectors can be improved by the addition of a J-M liquid system at low cost. Call or write — for an obligation free analysis of your problem of controlling dust, fumes or odors.

Johnson March

Dust Control Engineers

1724 CHESTNUT ST., PHILADELPHIA 3, PA.

CANADIAN REPRESENTATIVES: G. F. Sterne and Sons, Ltd., Brantford, Ontario

Circle 102 on READ-N-CIRCLE card for more data

ELIMINATE ERRORS in BATCH MIXING

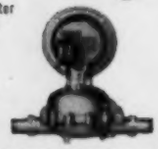
with

NIAGARA *Automatic Displacement Meters!*

SET FOR 175 gallons—GET 175 gallons

Uniformity of a liquid product depends on accurate measurement of all ingredients from batch to batch. You can be sure of consistent accuracy by equipping with Niagara Electri-contact Meters. A precision electric Switch closes or opens an electric circuit after the passage of a predetermined quantity of liquid through the meter. Can also be used to generate electrical impulses to actuate other control mechanisms . . . shut off a pump motor . . . signal visually or audibly to the operator. Brings automation to liquid control and measurement in hazardous or non-hazardous atmospheres.

Chemical Meter with inclined register.



Rear View. Explosion Proof Meter.

Begin now to lower your liquid measuring costs and have the assurance of positive accuracy. Mail coupon for complete information.

BUFFALO METER CO.

2933 MAIN STREET

BUFFALO 14, NEW YORK

Please send me complete information on the use of economical NIAGARA METERS, based on the data below:

Liquid..... Pressure.....p.s.i.

Temp.....°F.

Flow rate.....g.p.m.

Maximum batch.....gals.

Name.....

Company.....

Address.....

See us at the ISA Instrument Show in September.

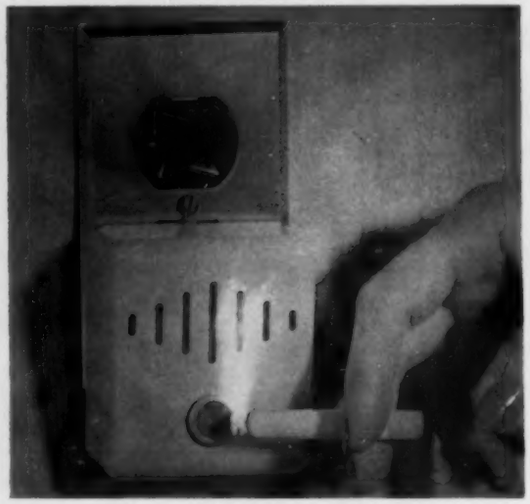
Circle 120 on READ-N-CIRCLE card for more data

new products

. . . starts on page 33

711-Fire alarm plugs into any ac outlet

Tiny new fire alarm that fits into any standard ac outlet gives audible alarm at first sign of fire or overheating. Portable alarm uses no current except when signaling. It is an excellent auxiliary to sprinkler sys-

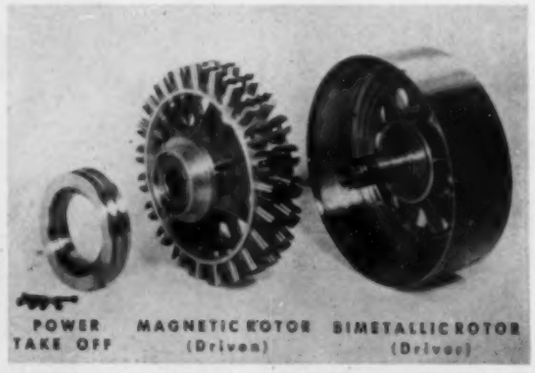


tems and substitute for other standard fire detection and fighting systems.

Alarm's sensitive thermostat triggers when ambient temperature reaches 140 F, and continues until temperature returns to about 100 F. LARAMIE CHEMICAL CORPORATION.

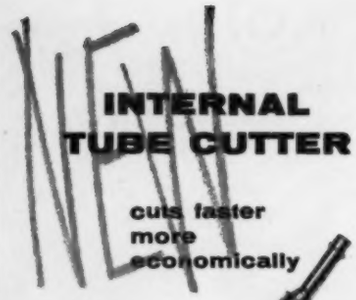
712-Age-old principle is modernized

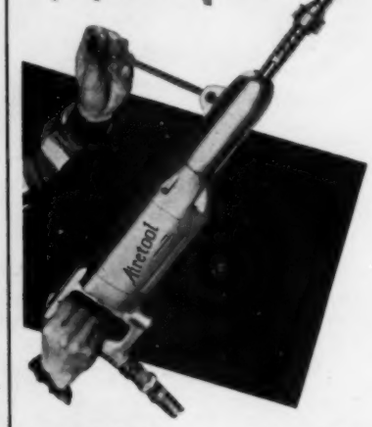
Magnetic drive provides flexible slip-type drive using eddy current principle. Magnetic drive consists of two component parts — a magnetic rotor, to which are attached strong Alnico permanent magnets, and a bimetallic rotor. When either part is driven, a torque is



induced in the other through eddy currents. Driving and driven rotors are separated with an air gap.

Drive can be run at full stall (100-percent slip) indefinitely without harming motor or magnetic drive. WHITNEY CHAIN COMPANY.





AIRETOOL'S new, lightweight, portable tube cutter removes heat exchanger and condenser tubes faster and more economically than ever. Self-centering, double-action hardened steel tool bits cut nonferrous and steel tubes. Positive feed control eliminates gouging, burning . . . increases life of tool bits. Equipped with powerful *new* air-driven motor, designed and built by AIRETOOL.

Cutter is also available with electric driven motor, or in push-type design adaptible for use with your own electric or air motors.

Send for Bulletin #59, illustrating the complete, new line of AIRETOOL Tube Cutters, cleaners, expanders, accessory and specialty tools.

AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.

REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.

EUROPEAN PLANT: Vlaardingen, The Netherlands

Circle 133 on READ-N-CIRCLE card

CONTINUOUS BLOW-OFF VALVE

Complete blow-off includes sedimentation chamber, cleanout valve, by-pass, Uniblow rotary disc valve.

"UNIBLOW" SAVES • FUEL • WATER • LABOR

Stainless rotary disc valve offers 15 calibrated orifices for any rate flow covered by flow chart. Sediment chamber protects orifices from plugging. Maintenance free. Keeps boiler cleaner. Insures accurate dependable control of boiler blowoff. Hundreds of installations prove Uniblow quickly pays for itself.

FREE BOOKLET "HOW TO CURE BLOWOFF PROBLEMS"

Money Back Guarantee

UNIBLOW VALVE CO.
1920 W. 77 ST. CLEVELAND 2, O.

Circle 140 on READ-N-CIRCLE card

ERNST
Boiler Accessories

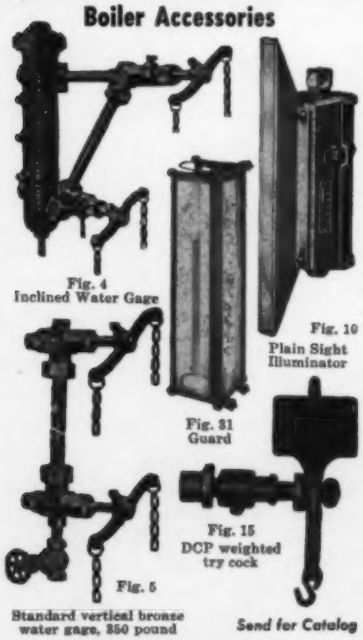


Fig. 4 Inclined Water Gage

Fig. 10 Plain Sight Illuminator

Fig. 81 Guard

Fig. 15 DCP weighted try cock

Fig. 5

Standard vertical bronze water gage, 350 pound

Send for Catalog

ERNST WATER COLUMN & GAGE CO.
Livingston, N. J.

Circle 107 on READ-N-CIRCLE card

713-Lubricant in spray bomb

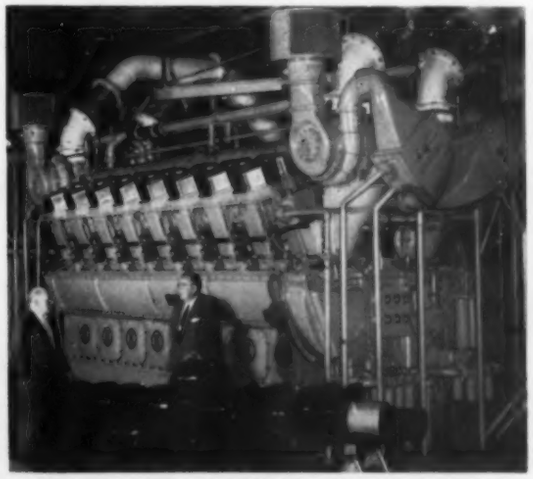
Spray-on, aerosol bomb contains air-dry solid film lubricant that dries in 30 minutes. Lubricant functions in temperature range from −300 F to +500 F. Recommended for parts operating at high speeds and extremely high loads. Lubricant is excellent for gears, actuators, cams, hinges, shafts, threaded parts, cylinders, and valves. Comes in 12-oz spray-bomb container. ELECTROFILM, INC.

MORE INFORMATION

For more detailed free information on these products just circle the key numbers on a READ-N-CIRCLE card on page 47 or 48.

714-7000 horses in two-story house

Huge 7000-hp diesel engine is as high as a two-story house, yet is smallest in the world for the power developed. New engine is a 16-cylinder, V-type engine weighing 95 tons. Unique connecting rod design permits opposite cylinders to be paired in the same plane. This reduces overall engine length by more than 20 percent. Can be furnished to operate on diesel fuel or natural gas. ENTERPRISE ENGINE COMPANY.



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STEAM or POWER models for any need

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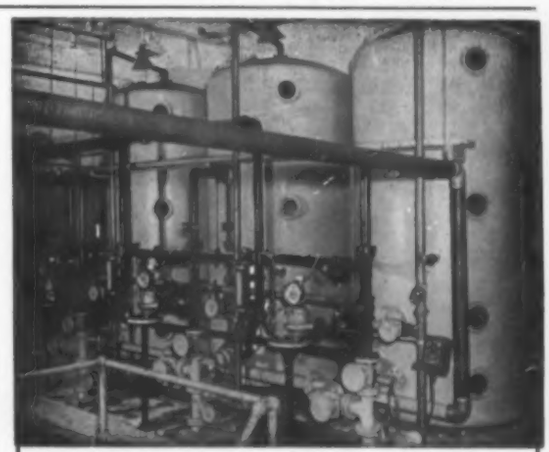

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new bulletins

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400-Diesel engine family from 550 to 2400 hp

Bulletin DE-6 contains dimensions and specification tables for three models in this family of diesel engines. Includes information on six-cylinder inline models and 12- and 16-cylinder V-type models. Gives data on fuel, lubricating, and cooling-water systems. Cross section view shows construction and operating details. Fourteen pages. ALCO PRODUCTS, INC.

401-Vibration and shock control charts

Three-color vibration isolation efficiency curve is offered in Bulletin 901. Chart for simple linear vibration shows percentages of vibration isolation or noise reduction obtainable with mountings of different static deflections. Also discusses vibration and noise magnification when system approaches resonance. Four pages. LORD MANUFACTURING COMPANY.

402-Interchangeable components change pumps

Complete interchangeability of pump components results in very flexible installation, as described in Bulletin B-1608. Pumps are offered in two basic designs with either enclosed or open impellers. Pump frame can be interchanged with back plate, impeller, and volute case to obtain desired performance. Lists pumps in discharge sizes from one inch through four inches. Capacities up to 800 gpm against heads of 400 feet are available. Twelve pages. PEERLESS PUMP DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION.

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403-Hose selector slide rule

Here's your chance to get a pocket-size slide rule for easy selection of rubber-covered Wiretex hose. Selector contains latest SAE and industry specifications on hydraulic hose. Covers hose diameters from 3/16- to 2-inch id and includes data on working pressures up to 5000 psig. REPUBLIC RUBBER DIVISION, LEE RUBBER & TIRE CORPORATION.

404-Piping is easy with rigid plastic pipe

Bulletin 10050 describes new pipe with high strength, light weight, and high chemical resistance. Lists chemical and physical properties of Koroseal pipe with recommendations for proper installation. Illustrations show how pipe can be bent easily after heating. Includes description of Koroseal diaphragm valve with same chemical resistance as Koroseal pipe. Lists common chemicals handled by pipe without damage. Eight pages. B F. GOODRICH.

405-Long-lived storage battery data

Economic advantages and application data for nickel cadmium storage batteries are contained in Bulletin 334. Lists features of greater reliability, lower maintenance cost, and much longer life. Covers control and standby batteries for switchgear, standby power, and emergency lighting. Four pages. NICKEL CADMIUM BATTERY CORPORATION.

406-Complete tube expander manual

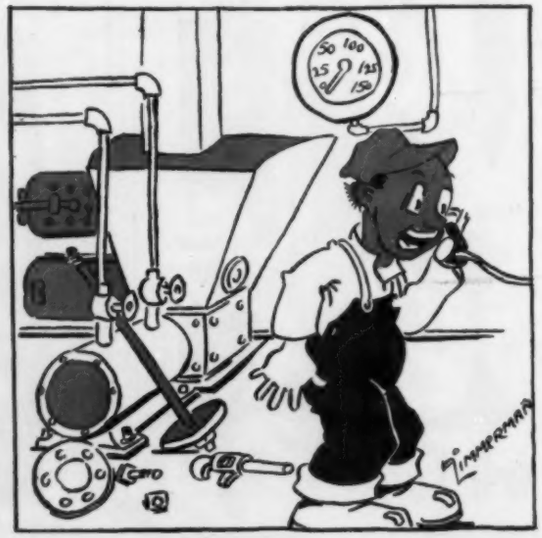
Detailed information on tube expanders, tube rollers, and associated tools is contained in Catalog 88. Lists many new tools and gives description of how each is used. Illustrations show tools used in maintenance of boilers, condensers, and evaporators. 119 pages. THOMAS C. WILSON, INC.

407-Package panels fill your needs

Instrument and control panels can now be selected for your power plant to meet individual specifications, as described in Bulletin G71-7. Six standard designs, completely tubed and wired, are ready to plug in on arrival. Panels and accessory equipment are factory assembled and tested. Includes cross section, of typical control panel mounting. Lists dimensions for each panel in the line. Sixteen pages. BAILEY METER COMPANY.

408-Clean your sedimentation basins

Mechanisms for cleaning rectangular sedimentation basins are discussed in Bulletin 6001-R. Includes sketches, line drawings, and installation photographs of units and components. Available for tanks from 10-feet to 100-feet wide. Blades sweep tank bottom, raking sludge into transverse hopper. On return trip, rake automatically rises off tank bottom. Lists five



Take it easy, Boss. I'll have th' stoker put together an' steam up in say about ten minutes.

typical installations with average yearly maintenance costs. Twelve pages. DORR-OLIVER INCORPORATED.

409-Balance your equipment in place

Bulletin 53 describes a new concept of in-place dynamic analysis and correction of unbalance. Bulletin shows operating principles of portable units with standard tunable pickup. Can be used for balancing parts operating between 225 and 3600 rpm. Case histories show how unit gives efficient, low cost balancing. Twelve pages. TINIUS OLSEN TESTING MACHINE CO.

410-Expansion joints from A to Z

Engineering data on full line of expansion joints from 3 to 72 inches in diameter are contained in Catalog 56. Gives selection chart showing how to choose correct joint for given conditions. Includes full dimensional and temperature data on all models in the line, both flanged and welding end. Seventy-two pages. ZALLEA BROTHERS.

411-Centrifugal pump capacity tables

Bulletin 100 explains construction and operation of "Cyclo-trell" including drawings, cutaway views, and collection efficiency and capacity nomographs. Tables give design data for six available sizes. Nomograph has illustrated example that shows how to determine collection efficiency capacity per tube, and total tubes required. Twelve pages. RESEARCH-COTTRELL, INC.

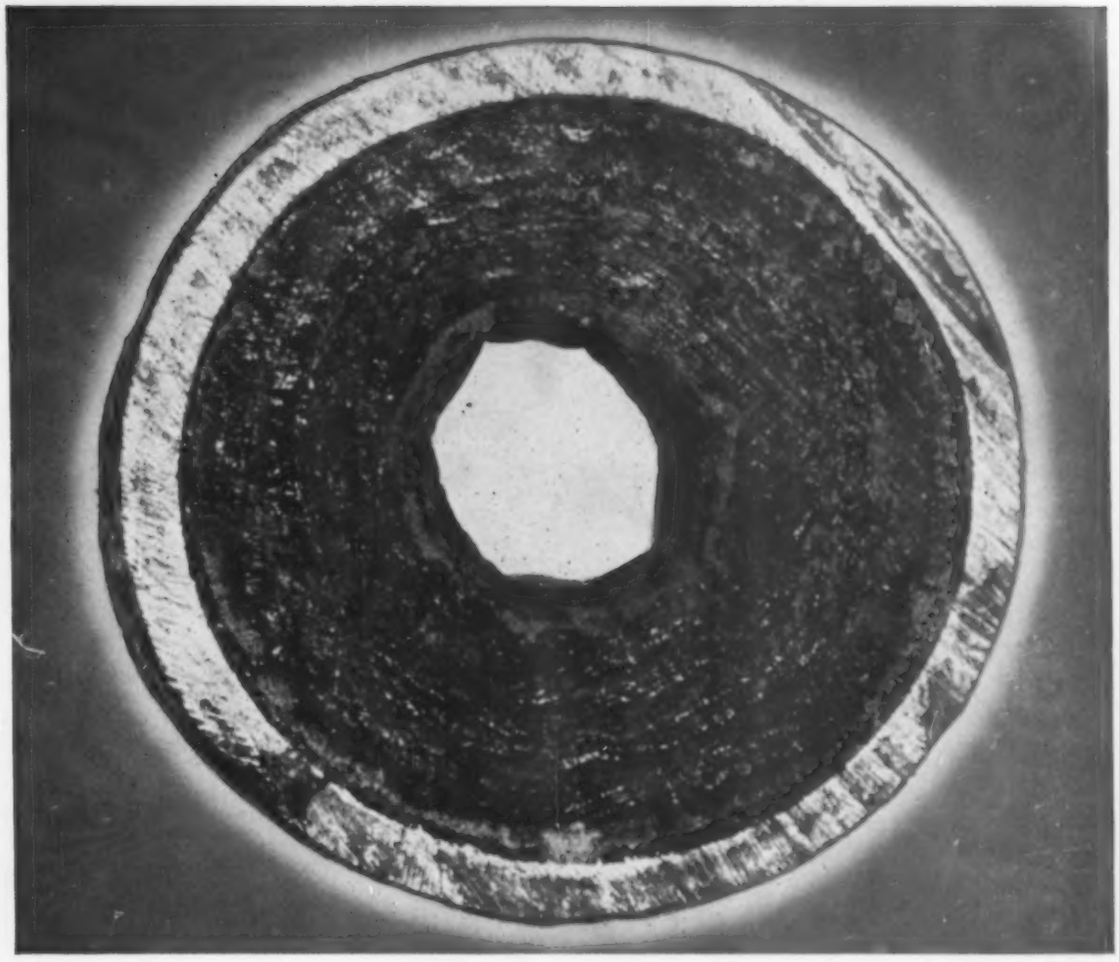
412-Cable splices get plastic protection

Instructions and application information for entire line of "Scotchcast" splicing kits is contained in this bulletin. Describes procedure for pouring field-molded splices with three types of splicing kits. Describes kits for inline splices, for weather-exposed or direct-burial locations, and for communication splices (either wye or inline). Lists epoxy resin containers with full instructions for use. Twelve pages. MINNESOTA MINING AND MANUFACTURING CO.

413-Hydroelectric penstock engineering data

Hydroelectric penstock construction in sizes from 30-inch to 18-foot diameter are discussed in Bulletin 656. Text describes construction features and special field couplings used on these projects. Shows step-by-step procedure for installing penstock couplings. Includes a list of penstock installations with penstock size and maximum working pressures. Twenty pages. DRESSER MANUFACTURING DIVISION, DRESSER INDUSTRIES.

♦ ♦



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AIR CLEANING EQUIPMENT

500-Series on dust and fume collectors

Exhaust fans for dust collecting and air handling are described in Catalog 1002-6. Includes complete performance tables and test curves. Plans and elevations of typical installations are shown. Separate bulletins contain descriptions, dimensions, capacities of Norblo bag type, hydraulic type, and centrifugal dust collectors. THE NORTHERN BLOWER CO.

501-Dust collector manual

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrester types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. KIRK & BLUM MFG. CO.

502-Improved electrostatic dust control

"Dust and Fume Control," Bulletin G406, tells how improvements and refinements have been made in electrostatic precipitation since the first Cottrell precipitator was erected. Also includes background material and illustrations of the Multiclone mechanical dust collector, the CMP unit—a combination Multiclone and Cottrell unit, Dualaire dust collector, and Holo-Flite processor. Eleven pages. WESTERN PRECIPITATION CORP.

AIR CONDITIONING, HEATING, VENTILATING

503-Gas-fired heaters save space

Advantages of gas-fired commercial and industrial heating units are fully described in Catalog GN-56. Includes data on suspended gas unit heaters, both fan and blower types, in capacities from 25,000 to 250,000 Btu. Lists specifications, construction details, easy-to-read dimension drawings, and selection tables. Describes how suspended heaters save valuable floor space for process operations. Twenty-four pages. REZNOR MANUFACTURING COMPANY.

BOILERS AND BOILER ACCESSORIES

504-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC, based on total dissolved solids in boiler water. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of boiler installation. HENSZEY CO.

505-Package boiler improvements

Seven-page Bulletin AXY-1 gives full operating details and describes changes that have been made in the Amesteam generator, which is factory assembled, for 15 through 200 psi pressures. AMES IRON WORKS, INC.

506-Answers to hot water problems

Answers to your hot water problems are given in Booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are thoroughly discussed and illustrated. PICK MANUFACTURING CO.

BUILDING CONSTRUCTION, MATERIALS

507-Complete data on nonshrink grout

Complete specifications and data on nonshrink grouting for heavy equipment, anchor bolts, building columns, and bridge seats are now available. Specifications give recommendations on storage, mixing, forming, placing, and finishing. Contains data on strengths, cold- and hot-weather precautions, finishing edges, and removal of leveling devices. THE MASTER BUILDERS CO.

508-Special manual for grating

All information and data vital to the plant engineer are given in this manual that covers all types of grating, open steel floor armor, stair treads, vessel liners, bridge decking, and drain grates. It includes safe-load tables, panel width constant charts, tables on standard widths and types of steel stair treads, and types of grating anchors. Booklet makes a handy reference tool. Sixteen pages. KLEMP METAL GRATING CORPORATION.

533-Reference book on Foamglas

Physical properties of Foamglas cellular-glass insulation, and suggested thicknesses for temperatures be-

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Somehow, I keep thinking of salted peanuts.

tween −50 and 800 F are offered in Bulletin 37-D-1, 2. Condensed specifications and application photographs make this a worthwhile reference book for engineers. Eight pages. PITTSBURGH CORNING CORPORATION.

ELECTRIC DISTRIBUTION

510-Fuses for every purpose

Fuses for every purpose are illustrated and described in Folder 3. Also discusses Econ dual-element cartridge fuses for time-lag to protect against overloads and Economy delay renewable fuses and renewable links. ECONOMY FUSE & MFG. CO.

511-Cable raceway for every job

Raceways for cable and conduit for all installation problems are discussed in this bulletin. Globetray can be cut to any length and quickly installed. Complete set of standard fittings is available to permit change of direction or elevation. Horizontal elbows, inside and outside vertical elbows, tees, crosses, covers, and special fastening devices save installation time and labor. Load data is given for typical installations. Eight pages. THE GLOBE COMPANY.

ELECTRIC GENERATION

509-Considering diesel-electric?

Bulletin 31922 describes the many different uses to which diesel-electric generating plants can be put. Cutaway drawings and illustrations show installations as auxiliary, emergency, and portable equipment. Lists advantages of compactness, ease of operation, maintenance, reliability, and power output. Sixteen pages. CATERPILLAR TRACTOR CO.

534-Lengthen your battery life

Storage-battery selection, charging, handling, maintenance, inspection, and testing for switchgear control are covered in the Plus-Performance Plan. Performance can be improved and battery life extended by as much as 50 percent. Read how in this collection of articles, specifications, charts, record systems, manuals, and bulletins. GOULD-NATIONAL BATTERIES, INC.

512-Guide to planning bus duct

Latest concepts of bus enclosure for generator leads and switching stations are given in Bulletin 10004-A. Includes guide of electric characteristics, ring size, working data, physical arrangement, and isometric installation layout. Gives recommendations for strength and simplicity for welded bus. Includes examples for installation and maintenance economy. Eight pages. I-T-E CIRCUIT BREAKER COMPANY.

513-Correct that low power factor

Booklet 50B describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. Twenty-seven pages. SPRAGUE ELECTRIC CO.

514-New variable transformer ratings

Types 136 and 236 Powerstat Variable Transformers —design, new ratings, and performance—are discussed in eight-page Bulletin P354. THE SUPERIOR ELECTRIC CO.

ELECTRIC UTILIZATION

515-All-purpose electric gearmotor bulletin

Latest design improvements in electric gear motors in capacities from 1/3 to 30 horsepower are described in Bulletin F-1880. Cross section illustrations show salient construction features. Single-, double-, and triple-reduction gearmotors are included, with operating characteristics of each. Includes lubricating details, and describes totally enclosed and explosion-proof models. Sixteen pages. U. S. ELECTRICAL MOTORS INC.

FUELS AND FIRING EQUIPMENT

516-Read about fuel oil additives

How to get complete protection from fuel tanks to burner tips is described in Bulletin 5012-A. Additives eliminate desludging operations, keep screens and burners clean, improve atomization and combustion, eliminate smoke and soot, and reduce rusting, pitting, and leaks. Includes recommended amounts of additive per 1000 gallons of fuel oil. Four pages. DEARBORN CHEMICAL COMPANY.

517-How to handle heavy fuel oils

"The Heating and Handling of Residual Fuel Oils," eight-page Bulletin 1601, covers heavy fuel oils for use in burners of boilers, furnaces, and processing equipment of industrial and commercial plants and buildings. Use of Preferred Ribbon Heat for heating piping lines is explained. PREFERRED UTILITIES MFG. CORP.

HEAT EXCHANGERS

518-Condenser tube inserts

How to restore leaking condenser tubes to service by sealing off the deteriorated portion with inserts, is the subject of four-page Leaflet 500. Tube cleaners, expanders, maintenance tools are listed. THOMAS C. WILSON, INC.

INSTRUMENTS AND CONTROLS

519-Temperature and pressure control

Through years of experience in instrument design and manufacture, this company has developed a specialized line of equipment for recording and indicating temperature and pressure. Seven-page Bulletin G-158-A shows typical examples of such equipment. THE ELECTRIC AUTO-LITE CO., INSTRUMENT AND GAUGE DIV.

520-Switches insure safe operation

Bulletin 856 contains information on full line of mercury switches and controls. Lists mercury switch controls for temperature, pressure, oil burner controls, stoker, liquid-level, and boiler feedwater pumps. Gives advantages of mercury switches, such as visible contact, elimination of contract wear, and seal from hazardous atmospheres, dirt, and corrosion. Fifty-two pages. THE MERCOID CORPORATION.

(continues on page 44)

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basic bulletins

. . . starts on page 42

521-Tachometer troubles tamed

Condensed presentation of nine different types of tachometers including portable, permanent, centrifugal, chronometric, and vibrating-reed types are described in Bulletin 1048. Tachometers are available in both rpm and surface-speed types with ranges from 30 to 48,000 rpm and from 5 ft/min to 2400 ft/min. Four pages. HERMAN H. STICHT COMPANY, INC.

522-Electric instrument manual

Engineering data on instruments for testing and calibrating current-actuated protective devices is contained in Catalog 3561. Application recommendations, illustrations, and schematic diagrams are listed in this catalog. Includes recommendations for electric maintenance personnel on safe techniques for rapid inspection of critical protective equipment. Includes full line of standard and special equipment. Sixty-eight pages. MULTI-AMP CORPORATION.

523-Temperature conversion chart

Handy two-color chart converts degrees Fahrenheit to degrees Centigrade over the range from −400 to +4000 degrees. Shows temperature ranges of different sensing elements. Thermocouples, resistance bulbs, and radiation heads are shown, with recommendations for installation and maximum limits for both continuous and intermittent service. THERMO ELECTRIC CO., INC.

LUBRICATION

524-Do's and don'ts for bearings

A helpful list of "do's" and "don'ts" to prolong bearing life appears in Bulletin 506. Also included is information on the storage and handling of industrial lubricants. Four pages. NEW YORK AND NEW JERSEY LUBRICANT CO.

MECHANICAL POWER TRANSMISSION

525-Power transmission encyclopedia

Here is a valuable reference book for all engineers interested in mechanical power transmission machinery. Completely covers base plates, bearings, chains, clutches, collars, couplings, keyseats, pulleys, shaftings, speed reducers, sprockets, takeups, and bushings. A special section is devoted to belts, drive tables, sheaves, and variable speed tables. Worth keeping on your book shelf. 328 pages. DODGE MANUFACTURING COMPANY.

PIPING, TUBING, AND HOSE

526-Plastic pipe handbook

Threaded- and socket-type fittings and flanges in both normal and high-impact grades are included in this bulletin. Includes installation information, pressure-temperature charts, chemical resistance tables, and other reference data. Polyvinyl chloride pipe material is resistant to corrosion, inert, non-toxic, and light weight. TUBE TURNS PLASTICS, INC.

527-Color code identifies pipe for safety

Reference chart outlines accepted use of color in safety practices for protecting property and personnel. May be posted in shop for quick, easy reference. Includes recommendations for pipeline identification by uniform safety color code. Lists five main classes and colors to identify each class: safe, dangerous, protective, valuable, and fire protective. Describes use of basic colors supplemented by symbols to make equipment identification easily remembered. THE ARCO COMPANY.

PUMPING EQUIPMENT

528-Sewage and sump pump selection

Comprehensive, eight-page Bulletin 325-A32 is for engineers, architects, and contractors who specify sewage and sump pumps. It describes in detail three types of pumps: The NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. AMERICAN-MARSH PUMPS, INC.

529-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON PUMPS, INC.

REFRACTORIES AND INSULATION

530-How to select refractory

"Boiler Refractories," 20-page Bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. BABCOCK & WILCOX CO., REFRACTORIES DIV.

531-Insulation, refactory handbook

Engineering data, formulas for calculating heat transmission, tables on heat losses from bare surfaces, and equivalent thicknesses of pipes are a part of the technical information contained in Bulletin IP-36A. Also includes descriptions of physical properties of the complete line of products. An excellent handbook containing information on all insulation and refractory problems. Fifty-two pages. JOHNS-MANVILLE.

541-Refractory construction

The different types of construction considered standard for individual refractory are described in Bulletin 39. Profusely illustrated. Twenty pages. BIGELOW-LIPTAK CORP.

TRAPS, STRAINERS, AND SEPARATORS

532-Steam trap manual

Real low-down on steam trap operation is contained in "Armstrong Steam Trap Book." Includes many illustrations of correct steam trap installations. Cutaway sections show steam trap operating principles. Lists steam traps for all sizes from ½ to 2 inch. Includes data on how to trap unit heaters, submerged steam coils and tubes, siphon drains, and low pressure heating systems. Includes illustrations of typical piping layouts incorporating steam traps. Forty-six pages. ARMSTRONG MACHINE WORKS.

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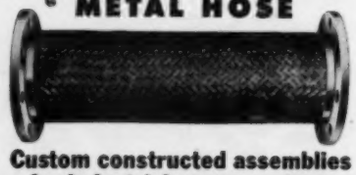

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542-Steam trap selector guide

Bulletin T-9 contains steam trap selector tables for 35 possible installations. Three-page fold-out diagram shows installation piping for 22 pieces of typical process equipment—with recommended steam trap and piping arrangements. Shows typical installations and gives recommendations for piping to obtain maximum steam trap efficiency. Twelve pages. YARNALL WARING COMPANY.

TURBINES

540-Speed control fundamentals

"Fundamentals of Turbine Speed Control," 32-page Brochure H-21, is an educational piece intended to clarify the operation of common types of automatic speed control for steam turbines. Simplified diagrams illustrate operating principles of actual control systems. ELLIOTT CO.

VALVES AND REGULATORS

535-Pressure valves for all ranges

Catalog 10 describes List 960 and 990 valves. The 960 is for a pressure range of 200 lb at 100 F to 380 lb at 1000 F. The 990 is for higher pressures. CHAPMAN VALVE MANUFACTURING CO.

WATER SUPPLY AND TREATMENT

536-Control valve reference book

Three basic types of single-seated diaphragm control valves are discussed in 15-page Bulletin 5304. Cutaway views and charts with complete specification data make this a good reference book. LESLIE CO.

HOW TO GET COPIES

To get a free copy of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on pages 47 or 48.

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WASTE DISPOSAL

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9. Examine test results.
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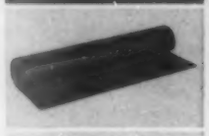

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names make news

. . . personalities from industry power

Hoover Medal Board of Award announces that **Herbert Hoover, Jr.,** under secretary of state will be 1956 recipient. Award, named after first recipient, former president Herbert Hoover, Sr., is sponsored jointly by AIME, ASCE, ASME, and AIEE. Herbert Hoover, Jr. is former president and board chairman of the United Geophysical Corporation. This is the first time in AIME history that a father and son have achieved so high an award.

President Eisenhower appoints **Judge Arthur Kline** to the **Federal Power Commission,** with the Senate unanimously confirming the appointment. Judge of the First Judicial District of Wyoming since 1953, Kline has also served as commissioner on uniform state laws and as assistant attorney general for the state of Wyoming.

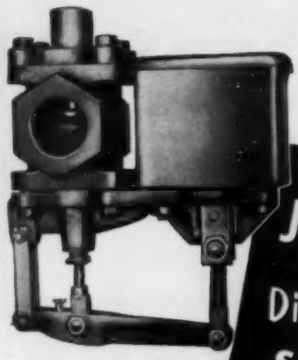
Stanley

Hanna

Harvey T. Hill retires from the **Diesel Engine Manufacturers Association** on January 1, 1957. **Robert L. Stanley** present technical director, will take over the reins on that date. Headquarters moves from Chicago to Washington, D. C. on December 1.

AIEE awards the 1955 **Lamme Gold Medal** to **Dr. Clinton R. Hanna,** associate director of research, Westinghouse Electric Corporation. Dr. Hanna holds more than 100 patents in the fields of sound reproduction, hydraulic servomechanisms, gyroscope stabilization and aircraft automatic pilots.

AIEE will honor inventors **Nikola Tesla** and **Charles F. Kettering** and educator **Dr. F. E. Terman** at its Fall General Meeting in Chicago. Centenary of Tesla's birth will be meeting theme. He was inventor of ac electric motor and other electrical equipment. Kettering is director and former vice president of General Motors Company. He is inventor of automobile self-starter, lighting, and ignition systems. Dr. Terman, provost of Stanford University and dean of School of Engineering, will be first recipient of new Members-for-Life Fund Medal awarded annually to a teacher of electrical engineering. He is the author of several books.



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Stainless steel valve and seat. Sizes: ½" to 3". Write for facts.

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THE JOHNSON CORPORATION
807 Wood St., Three Rivers, Mich.

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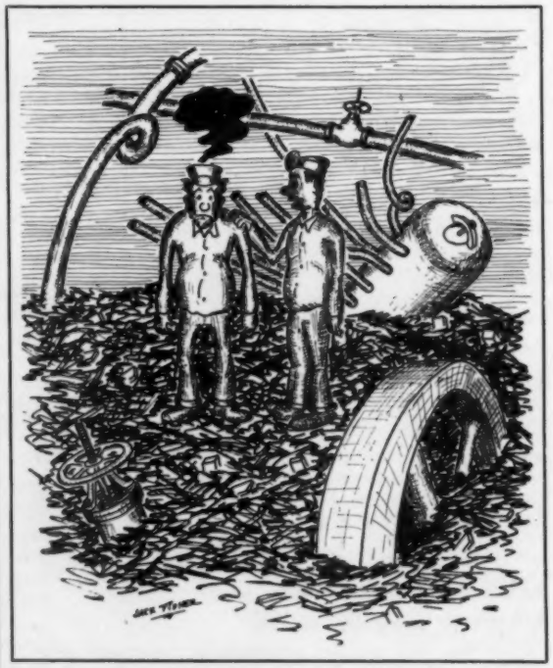

Don't take it so hard, Finnegan. Every engineer loses the load at some time during his career.

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Read page 37 and circle number 102
JOHNSON-MARCH CORP. No costly ducts, hoods, or fans are needed with this liquid system of dust control. Can be added to existing installations.

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THE TEXAS COMPANY. Texaco oils give extra protection, last longer. Select exact oil to meet your turbine needs.

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Handling bulk materials?
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CANTON STOKER CORP. Flo-tubes will handle fine or lumpy materials on any incline. Guaranteed by specialists in the field.

(more handy guide on page 50)

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SAVES YOU MONEY!

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.. Keeps your Oil and Equipment Clean

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Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.

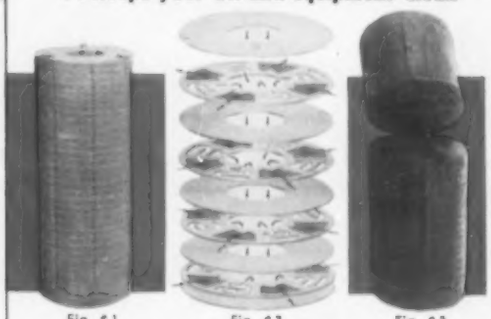

Fig. #1 Fig. #3 Fig. #2

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The result of much research in the field of lubricating, fuel and industrial oil filtration, the new patented HILCO Filter Cartridges meet the need for tremendous filtering area, low pressure drop and high dirt storage capacity. Above: Fig. 1 is a new cartridge; Fig. 2 is a used cartridge (note that pockets are completely filled and the outer surface covered with solids); Fig. 3 shows the flow of oil, the dark area represents dirty oil passing into the pockets while filtered oil (white area) passes into "S" shaped section.

HILCO Purification Means *Complete* Oil Purification . . .

You get absolute removal of sludge, acids, carbon, water and fuel dilution with a properly selected HILCO. Clean oil saves you money. Expensive maintenance is reduced, equipment shut-downs practically eliminated, lost man hours and cuts in production become a thing of the past. HILCO continuous, all electric, automatic purification keeps your oil clean and in top condition at all times. You receive the full capacity and economy of your equipment.

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Get longer V-belt life
Read page 44 and circle No. 137
RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIVISION. Condor V-belt engineering gives smoother running, cooler running drive for longer belt life with heaviest loads.

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Seamless metal hose
Read page 44 and circle No. 138
COBRA METAL HOSE. Use custom-constructed hose assemblies for your power system. All sizes available in most metals.

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Read page 46 and circle number 141
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Read page 26 and circle number 142
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For long-lasting valves
Read page 43 and circle number 143
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Read page 22 and circle number 144
LESLIE CO. Quartet of control pilots create 24-hour-a-day harmony. Pressures stay at set point for top efficiency of process equipment. Send for Bulletin 5303.

Half as many parts
Read page 54 and circle number 145
THE CHAPMAN VALVE MANUFACTURING CO. Simplified yet rugged construction of these motor units means less trouble, lower maintenance, and longer operating life. Can be completely wired at factory ready to hook up.

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Test your own water
Read page 45 and circle number 146
SALEM-BROSIUS, INC. Get fast, economical, and accurate bacteriological analysis of water with a Sabro portable laboratory.

Readymade, pretested deionizers
Read page 36 and circle number 147
ILLINOIS WATER TREATMENT CO. Hook an Illco-Way factory-tested and assembled unit into your lines. Select from three series of models for degree of water purification and type of treatment you need. Write for full details.

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Read page 41 and circle number 148
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THE BIRD-ARCHER COMPANY. Solve problem of return line corrosion with Bird-Archer amine treatment. Save on cost of piping replacement, maintenance work.

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Read page 9 and circle number 150
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Demineralizers built in all sizes
Read page 39 and circle number 151
HUNGERFORD & TERRY, INC. A complete line of water conditioning systems is available. Investigate these fully guaranteed, highest quality units by writing for details now.

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Circle 124 on READ-N-CIRCLE card

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A permanent position for a graduate engineer with experience in steam-electric power plant design is available in a large diversified pulp and paper manufacturing plant in the Upper Midwest. Our employees know of this opening. Reply giving personal, educational, and work history together with salary thinking. Your reply will be kept strictly confidential. Write Box H23, INDUSTRY POWER, St. Joseph, Michigan.

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Practically new 200 KW steam turbine generator, used as standby machine in food processing plant in Memphis, Tenn. for last ten years, cost new then more than $13,000; can be converted from DC to AC for $5,135. Today's new price, approx. $18,000. Offered subject to prior sale for immediate delivery, f.o.b. Memphis, complete at only $7,500. Might take less for "quick sale". Dealers invited, details by writing Box No. H22, Industry Power, St. Joseph, Michigan.

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spotlight on you . . . .

Some months ago we conducted a valve survey among our readers. Did you receive a survey form and return it? If you did, you'll recognize the information below. If you didn't (we only surveyed every 20th reader), here's a chance to compare your plant with the surveyed group. (This is a significant group, we might add, since INDUSTRY POWER's 45,000 circulation reaches 35,000 of the top manufacturing plants, utilities, service industries, and engineering firms in the country.)

valve research questionnaire

Valve research questionnaire returns indicate that 65 percent of the valves in the plants that responded are bronze, 16 percent are cast iron, 11 percent are cast steel, and 8 percent are forged steel. A small fraction of the steel valves are stainless steel, and small portions of the other kinds are corrosion resistant.

More than 49 percent of all valves in these plants fall in the two lowest-pressure groups listed in the questionnaire for each metal. Of the bronze valves in use 14 percent are rated for 100 psi, 36 percent are 125 psi, 37 percent are 150 psi, 9 percent are 200 psi, and 4 percent are 300 psi. Very few bronze valves are reported at higher pressure.

Of cast iron valves in use, 4 percent are rated 25 psi, 75 percent are 125 psi, and 21 percent are 250 psi. With only one-fourth as many cast iron valves as bronze, the high percentage in the 125-psi group indicates usage at this pressure of about one-half as many iron valves as bronze.

Classification of steel valves by pressure range in the survey does not separate cast from forged products. For all-steel valves, the survey shows 27 percent are 150 psi, 30 percent are 300 psi, 6 percent are 400 psi, 26 percent are 600 psi, 4 percent are 900 psi, 3 percent are 1500 psi, and 6 percent are 2500 psi. Very few reported go up to 6000 psi.

Average number of valves in use in each plant reporting is 2426. Utilities show the largest plant average. Miscellaneous manufacturing shows the smallest. Considerable diversity exists in valve use among firms reportedly producing the same product, indicating either a great difference in product classification or in processes.

of interest in buying practices

Some 95 percent of the persons responding indicate they influence the selection of valves. Only about one-third of the firms buy a single brand of valves in all three materials—bronze, cast iron, and steel. Nearly 78 percent of the reporting firms indicate that one valve company carries a nearly complete line for their purposes. Yet, about one-fourth of these firms named another company as their principal supplier.

Sectional preferences influence buying habits, it seems. Major differences exist in valve preferences by regions. The Midwest's composite choice is not New England's preference, for instance. Returns were received from all states except seven. (These seven are more noted for climate and scenery than for industry.)

Sixty-seven names of valve companies or brands were reported, excluding suppliers indicated as jobbers. About 20 percent of the firms buy all valves from a single supplier.

Nearly 60 percent of the reporting firms use more valves than before. Plant expansion is given most frequently as the reason. Other reasons given are improvement of operation and reduction of downtime. Most frequent reasons given for *not* increasing valve use are no change in plant and better-lasting valves limiting replacement needs.

An average of 1133 gate valves each was reported by 168 firms. About 42 percent of these gate valves are opened and closed frequently. About 2 percent of these gate valves are motorized.

An increased use of lubricated plug valves is reported by 30 percent of firms mentioning this item.

Control valves are used (in order of frequency) for steam, water, compressed air, gas, oil, and vacuum service.

These are the findings of the valve research inquiry. They represent what you have told us about the many manufacturing plants, utilities, and service industries where INDUSTRY POWER is read. ♦ ♦

It is an obligation for INDUSTRY POWER to have this knowledge available. The more we know about you, your plants, your equipment, the more fulfilling a job we can do. Our objective is to give you more benefit per square inch of reading time within the pages of INDUSTRY POWER than can be found anywhere else.

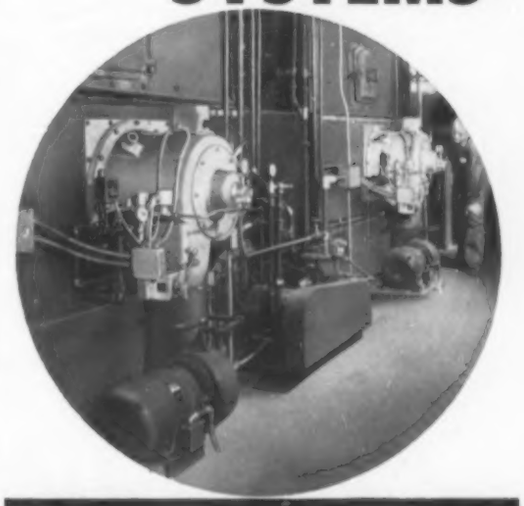
That's the why and wherefore of these surveys. They are conducted as a reader service. We will continue to send questionnaires to you from time to time. We will continue to report the results you send us in *spotlight on you*.

Have you sent in your entry

to INDUSTRY POWER's Power Show Contest? Do so now! Did you ever stop to think that, collectively, you form the foundation of industry? Without power, there is no industry! Here's a chance to demonstrate the true value of Power Service Engineers. Contest closes Sept. 7, so mail in the entry on page 8 today.

Modernize to SAVE *with* . . .

O&S BURNER SYSTEMS



Money-saving Firing Performance

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Now . . . the same efficient O&S burners that help to give O&S *Powermaster* packaged boilers their outstanding dependability and economy are adaptable to existing boiler installations and other kinds of industrial heat exchangers!

O&S burner systems are *complete* packaged combustion assemblies for gas, light or heavy oil, or combination gas/oil firing. They include burner, automatic controls, forced draft air supply, full modulation firing control, ignition, complete piping and wiring, refractory required for proper installation in combustion chamber. Many of these units are now in service—proving their cost-saving advantages on a wide variety of applications. They provide the greatest flexibility of application available in burner assemblies for modernization of existing equipment or for new installations.

If you are looking for ways and means to improve fuel-burning efficiency and performance on oil or gas fired equipment, it will pay you to get full information on O&S burner systems. Send for Bulletin 1231.

Builders of Dependable Boilers Since 1885

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Circle 117 on READ-N-CIRCLE card for more data

In brief . . . .

ASME 1956 Semiannual Meeting

ASME's 1956 Semiannual Meeting convened in Cleveland's Hotel Statler early this summer. Here are excerpts from three vital papers presented at that meeting:

Multi-fuel firing of cyclone furnaces

G. A. Watts, Superintendent of Product Research and Development, and W. L. Sage, Research Engineer; Babcock & Wilcox Company Research Center.

"The cyclone furnace can be described as a water-cooled horizontal cylinder in which fuel is fired, heat released at extremely high rates, and combustion essentially completed. Combustion air is admitted tangentially to create a whirling or centrifugal action which causes the solid fuel particles to move to the periphery of the combustion chamber, where their movement is retarded by the molten slag covering its walls. Although the finer fuel particles burn in suspension, the cyclone method of combustion is primarily a surface-burning process. The solid fuel particles in the liquid ash coating on the walls are scrubbed by the incoming air stream and burn at high combustion rates. Full load heat release rates in present day cyclones are approximately 800,000 Btu per square foot-hr of wall surface. Based on volume, this represents a heat release rate of 900,000 Btu per cubic foot-hr for a 5-foot diameter cyclone or a 500,000 Btu per cubic foot-hr for a 9-foot diameter cyclone.

"To maintain a liquid ash coating, a solid fuel must have a sufficiently high ash content and the ash must be liquid at the temperatures existing in the furnace. The minimum amount of ash required for this purpose has not been specifically determined, but experience with petroleum cokes indicates at least 4 percent is desirable. As far as the upper limit is concerned, it has been found experimentally that an ash-content equivalent to 50 percent of the dry weight of the fuel is about maximum that can be handled satisfactorily . . . .

"Field experience and laboratory testing have established the fact that the cyclone furnace can be used to burn solid fuels such as bituminous coals, lignites, and coal chars individually or in combination. Liquid or gaseous fuels also can be burned in a cyclone as combination fuels, or as alternate fuels, at reduced air pressures to improve economy.

"Other fuels that can be burned in combination with coal, oil, or gas include petroleum coke, petroleum pitch, wood waste, and coke breeze. When a combination includes a solid fuel, ash content must be sufficient to provide a liquid coating on the walls of the cyclone.

"In general, these waste or byproduct fuels can be used with little or no preparation, the major requirement being that they be fed to the cyclone at a uniform feed rate."

A new way to simplify power plants

H. A. Kuljian, President, and W. J. Fadden, Jr., Chief Mechanical Engineer; The Kuljian Corp.

While the supercritical-pressure stations constitute a radical change in power plant practice, by far the greatest change now imminent is the use of nuclear energy for generating electric power. Naturally, more complex equipment will be added. It is, therefore, of paramount importance that the feedwater heating cycle be kept as simple and as effective as possible. . . .

"The basic concept of incorporating all the stages of feedwater heating in a single compact shell reduces cost by: (a) requiring greatly simplified piping; (b) reducing the number of engineering drawings; (c) reducing installation cost and time; and (d) reducing building volume, particularly valuable floor space. In the aggregate, these four economies indicate a total saving of from $10.00 to $15.00 per installed kilowatt.

"Two types of combined heaters are offered for both power plants and industrial plants. . . . The Type K feedwater heater is basically a series of closed shell-and-tube type heaters that have been combined in a single vertical shell, and factory-built and tested as a single unit. Flow is accomplished by pumping feedwater directly from the condenser hotwell through the coils of the stages directly to the suction of the boiler feed pumps. . . .

"The new Type K-F feedwater heater uses standard tray-type open heaters and deaerating heater, as now manufactured, which are combined in a vertical tower. Flow from one heater to another is accomplished by gravity. . . .

"The complicated feedwater heating apparatus in present-day power plants must be simplified. The use of a single, integrated, multiple heat exchanger will substantially reduce building size, piping systems, erection time, and many other costs. Both the types described above are designed to meet this need for streamlining the modern power plant."

Exhaust ventilation design

K. M. Morse, Chief Industrial Hygiene Engineer, United States Steel Corporation.

"Basic purpose of contaminant ventilation is the maintenance of health and comfort. The criterion utilized to determine the effectiveness of such systems is whether or not the atmospheric concentrations of the various contaminants have been reduced to below unhealthful or otherwise hazardous limits.

"However, in practice, the actual engineering design is conducted by plant engineers, based upon the engineering standards — as, for example, the type of hood design, control and transport velocities, and collector efficiency — which are provided by the industrial hygiene engineer. It is in the absence of the industrial hygiene engineer that the safety engineer should become allied with contaminant-control-ventilation problems to some degree. Good contaminant-control ventilation, therefore, results from integrating the efforts of the plant and industrial hygiene engineers, supplemented by the efforts of the safety engineer. . . .

"I believe that the safety engineer can best contribute to the effectiveness of exhaust-ventilation systems by insuring the development of an adequate maintenance and testing schedule. In my experience, few machines or equipment receive less maintenance and testing than exhaust systems, despite the fact that such systems are often costly to install and replace. The mere operation of the fan does not insure adequate system performance.

"An adequate maintenance program should involve three phases:

"1) Design system sufficiently rugged to withstand the type of use and abuse expected.

"2) [Provide] the type of installation to insure convenient routine cleaning, inspection, removal, or replacement of any part.

"3) Establish a routine procedure for inspection and testing, including maintenance of adequate records.

"A system is not adequate simply because someone says so. Only performance data can be accepted as indicating effectiveness." ♦ ♦

good books

. . . for industry power

Readers wanting to obtain copies of these books may order through INDUSTRY POWER. *Send check covering cost and we will forward your order to the publisher.*

Analysis of Electric Circuits, by William H. Middendorf; John Wiley & Sons, Inc.; 306 pages; $6.00.

Text gives fundamental treatment of ac and dc circuit analysis developed logically from six basic laws of physics. This book shows how algebra plus an understanding of the basic laws will advance the reader's knowledge of electric circuits. This book is written with emphasis on developing ability to think. Examples and problems challenge reader's intellect and develop original thinking ability.

Text is arranged in three sections. First section provides knowledge necessary to solve problems met in usual undergraduate work. Last two sections extend scope of the work for electrical engineers. A valuable chapter is also included on communication circuits.

Illustrations consist entirely of line diagrams. Typography and composition are compatible with easy reading. A firm foundation in higher mathematics is necessary to obtain maximum benefit from this book.

Handbook of Welded Steel Tubing, by Formed Steel Tube Institute, Inc.; 267 pages; $10.00.

This handbook is divided into two separate sections. Part One discusses all phases of carbon steel tubing manufacture, including physical properties. Lists regular and special shapes available. Illustrations show fabrication methods for cutting, bending, and upsetting regular as well as special tubing shapes. Includes section describing many typical applications of tubular steel products.

Part Two contains similar information on stainless steel tubing, with emphasis on corrosion resistance and unique applications of stainless. Includes numerous tables and charts listing physical and chemical properties of stainless steel alloys.

Design data section lists dimension tolerances and cross section characteristics for strength determinations with various tubular sizes and shapes. Includes data on both round, square, and rectangular sections.

Typography and illustrations are above average. Volume is bound in two separate parts with spiral wire binding.

Problems and Control of Air-Pollution, edited by Frederick S. Mallette; Reinhold Publishing Corp.; 80 pages; $7.50.

This book comprises the proceedings of the First International Congress on Air Pollution, held under sponsorship of ASME. Contents range from discussions of public opinion to highly technical aspects of dust collector design. Chapters are included that give results of air-pollution control measures in foreign lands.

Typography and illustrations are average. Extensive bibliographies are included for further information on any phase of the subjects discussed. ♦♦

available reprints

. . . from industry power

Single copies of following reprints are available free. Quantity orders for individual reprints quoted on request. Address all correspondence, on company letterhead, please, to Reader Service Department INDUSTRY POWER, Commercial Bank Building, St. Joseph, Michigan.

- *Automatic Control for Variable Speed Transmissions*
- *Big Savings for a Small Plant*
- *Coal Dust . . . Stopped Before It Starts*
- *Cool your plant with central units*
- *Correction Table for Estimating Heating Value of Coal*
- ★ *Corrosion can conquer your grounding system*
- *Eliminating Expansion Joint Maintenance*
- *For Better Lighting at Less Cost, Frost Your Windows*
- ★ *Grounding can stop insulation failures*
- *High-Frequency Fluorescents*
- *Lessons for Multi-Building Plants High-Temperature Water*
- *More Steam for Less Money*
- *Nearest Thing Yet to a Completely Automatic Power Station*
- *New Chemical Grouting Method Prevents Flooded Floors*
- *Permanent Tank Insulation Costs Less*
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- *Put Dissolved Air to Work*
- *Selecting Fuel and Firing Equipment*
- *Selecting Taps on Power Transformers*
- *Shell Selects Package Boiler for Outdoor Operation*
- *Small Filters Do Big Job*
- ★ *Standard switchgear offers tailor-made job fast*
- *Tailor-Made Fire Protection*
- *Television . . . The Eyes of Industrial Control*
- ★ *What to do about anion resin deterioration*
- *What You Should Know About Fuel Oil Additives*
- *Why High-Temperature Water?*
- *Why Not Try Simplicity in Valve Controls?*

★ Reprints newly available since last month

Special Report reprints

Individual copies of Special Report Reprints will be sent free upon request. Additional copies are priced as follows: 2 to 24 copies are 25¢ each; 25 to 49 copies are 20¢ each; 50 to 99 copies are 15¢ each; more than 99 copies are 10¢ each. Special Report Reprints available are:

- *Adjustable Speed Drives and Electric Controls*
- *Combating Corrosion From Industrial Chemicals*
- *Contaminants in the Air*
- *Demineralization—A Means to Purer Water*
- *Inplant Electric Distribution*
- *Review and Forecast, 1956*
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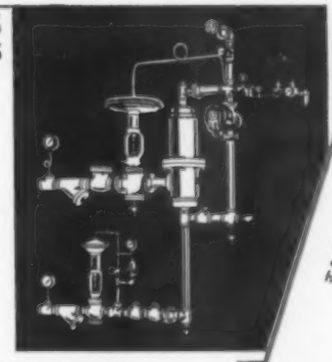
Pick INSTANTANEOUS HOT WATER HEATERS

Pick STEAM INJECTION WATER HEATERS



ENGINEERED FOR SERVICE

Industries everywhere are replacing outmoded water heaters with Pick Instantaneous Water Heaters. Here are the reasons:

- ✔ HIGH OR LOW LOADS — Continuous or intermittent flow with negligible temperature fluctuation.
- ✔ WATER IS HEATED INSTANTLY. Entirely automatic, Water is heated in a flash to exact temperature by Steam Injection.
- ✔ FUEL SAVINGS ARE SUBSTANTIAL. No waste because water is heated only as used. Never stored and allowed to cool.
- ✔ NO STORAGE TANK REQUIRED. Compact design permits installations in out-of-the-way areas in corners, on walls or overhead. Saves valuable floor space.
- ✔ MAINTENANCE COSTS ARE LOW. Can be cleaned in a matter of minutes.
- ✔ INSTALLATION IS INEXPENSIVE. Only ordinary pipe connections are required.

PICK MANUFACTURING CO.
WEST BEND, WISCONSIN

Bendix Aviation Corporation
HAMILTON DIVISION

Pick Manufacturing Company,
West Bend, Wisconsin

October 27, 1955

Gentlemen:

The Pick Instantaneous Water Heater installed in this plant two years ago has solved most satisfactorily our problem of furnishing both continuous and also large intermittent requirements for hot water.

BENDIX AVIATION CORPORATION
Hamilton Division
D. R. Baird
Plant Engineer

SOLVED SMALL AND LARGE CONTINUOUS HOT WATER REQUIREMENTS FOR BENDIX AVATION CORP.

Other Industrial users are . . .

- United States Steel Corp.
- Ford Motor Co.
- H. J. Heinz Co.
- Bethlehem Steel Co.
- Wilson & Co.
- National Gypsum Co.
- National Aniline
- General Aniline

WRITE TO DEPT. IP-556 FOR BOOKLET ON HOW PICK HEATERS CUT COSTS OF HOT WATER.

Circle 105 on READ-N-CIRCLE card for more data

In the
PINK
of Condition

CHAPMAN MOTOR UNITS

We've done one thing for you. Chapman's Motor Units . . . for operation of valves, floorstands and sluice gates . . . are in the best of condition for accurate performance and longer, lower cost life.

We've made them as you like them . . . simplified them . . . streamlined them . . . taken off all the fat. In fact, when you look at a Chapman Motor Unit today, you can only find approximately *half as many parts* as on any other unit.

This simplicity, combined with Chapman's traditional ruggedness, means less trouble and lower maintenance over a longer period of smooth, accurate performance.

How can you go wrong? With Chapman Motor Units, the simplified design . . . the sturdy construction . . . mean no drift; less slash, accurate micrometer-controlled limit switch for predetermined seat tightness; quiet motor driven operation at all *times*. All at the lowest overall cost.

No trouble with operating positions. Operation is assured at any angle. Rugged stub-tooth gears need no grease or oil. No trouble with operating conditions. All units are weatherproof . . . *steam tight*. No trouble even with installations. When used with floorstands they are completely wired at the factory . . . ready to connect with your leads. Easy and simple to install.

Get our new catalog . . . Catalog 51 . . . on Chapman motor units today.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

Circle 145 on READ-N-CIRCLE card for more data

coming events

. . . for industry power

Sept. 17-21	Instrument Society of American 1956 Conference and Exhibit	Coliseum New York City
Sept. 25-27	Third Annual Conference Atomic Industrial Forum	Morrison Hotel Chicago
Oct. 1-5	AIEE Fall General Meeting	Morrison Hotel Chicago
Oct. 8-10	ASME Lubrication Conference	Atlantic City New Jersey
Oct. 11-12	Armour Research Foundation National Noise Abatement Symposium	Sherman Hotel Chicago
Oct. 22-24	Seventeenth Annual Water Conference	Hotel Wm. Penn Pittsburgh
Oct. 24-25	ASME Fuels Conference	Washington, D. C.
Nov. 25-30	ASME Annual Meeting	Hotel Statler New York City
Nov. 25-30	ASME Power Show	Coliseum New York City
Nov. 26-30	Third International Automation Exposition	Trade Show Building New York City
	1957	
Jan. 21-25	AIEE Winter General Meeting	Hotel Statler New York City

next month in
INDUSTRY POWER . . . .

How steam serves McClouth Steel

One of the best planned steam generating and distributing facilities in industry is the new Trenton, Mich., plant of McClouth Steel Corp. Combination fuel firing, water supply, turboblowers, and combustion control are among many features that make this power plant interesting.

Complete listing of equipment and ratings pins down operating conditions so you will have as much information as if you read the nameplates yourself. INDUSTRY POWER will take you to Trenton next month for the full story. Your guide will be the project engineer in charge of the plant's design. Look for this feature, in our Putman-style format, next month in the

October issue of INDUSTRY POWER

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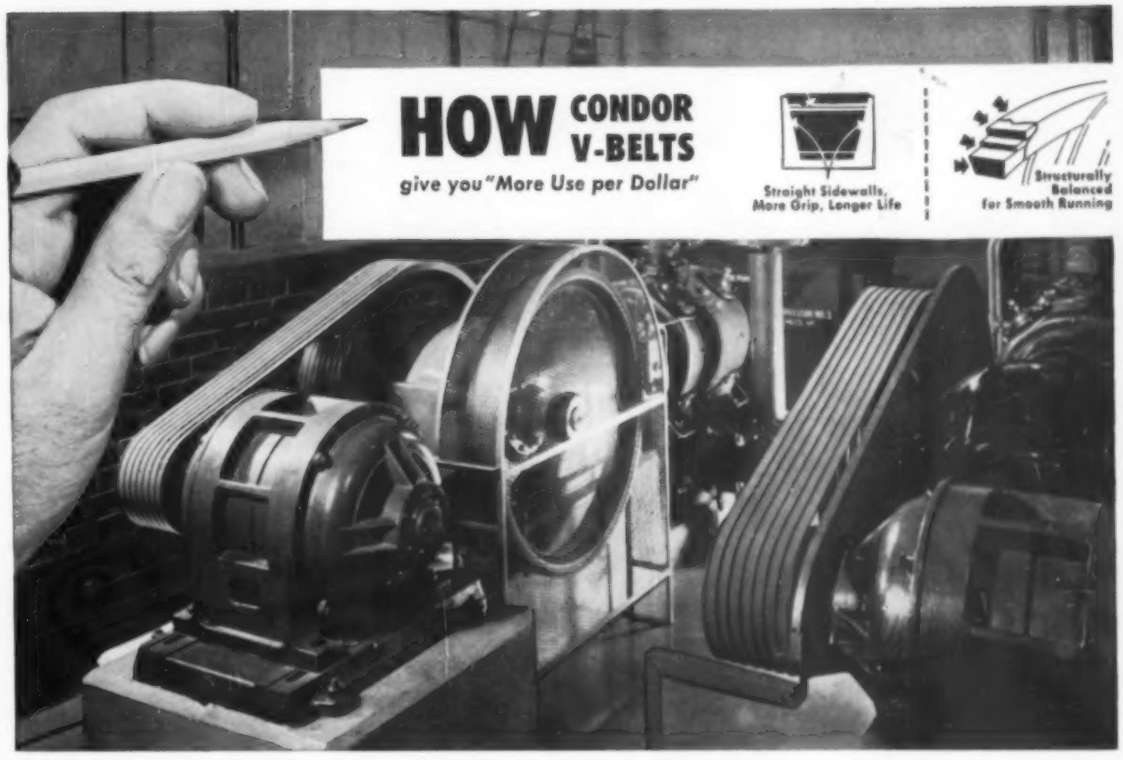
HOW CONDOR V-BELTS
give you "More Use per Dollar"
Straight Sidewalls, More Grip, Longer Life
Structurally Balanced for Smooth Running

These Smoother Running V-Belts Lower Your Operating Costs

Condor V-Belt engineering makes the difference. The strength member is micro-positioned in heat dissipating rubber for a smoother running, cooler running drive . . . for longer life with the heaviest power loads. Condor V-Belt sidewalls are made *straight* to put positive pressure on the sheave grooves for more grip . . . less slip. Straight sidewalls help support the super-strength synthetic cords of the belt in a straight line so that *all* cords pull equally . . . deliver their maximum share of power. Controlled length is accomplished through prestretching during manufacture to remove inelastic stretch that might otherwise occur on the job.

NOW . . . Moisture-Proof Vacuum Packaging

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